

MANAGEMENT OF MINOR FOREST PRODUCE FOR SUSTAINABILITY

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Foreword

Forest management in India is about 130 years old. The principle of forest management is based on sustainability both in tangible and intangible forms. The classification of ‘Major’ and ‘Minor’ forest produce has been done *according to the type of produce available from forest*.

Initially more emphasis was laid on timber with a marginal stress on other minor forests produce. Growing population and its consequential demand on forest has put sustainability under great stress. Felling of trees from forest in our country has been greatly restricted and in some states already banned having felt the need for maintaining tree cover in the land surface. Tree-cropping is a long term enterprise whereas minor forest produce is harvested annually and has great relevance in the contemporary context. Gradually with the new concept of Joint Forest Management considerable emphasis is put on harvesting MFP (now Non Timber Forest Products–NTFP) scientifically and sustainably.

The President and Managing Director of the Centre of Minor Forest Products, Dehra Dun, Dr. M. P. Shiva has been organising International and National Seminars from time to time wherein eminent forest scientists and professionals have contributed useful papers and deliberated at great length. In this book ‘Management of Minor Forest Products for Sustainability’ Dr. Shiva has tried to edit and consolidate all the papers with an attempt to catching the thematic essence of the subject matter.

The Book will be quite informative and interesting for all concerned with present day concept of forest management and its sustainable development.

New Delhi

M. F. AHMED
IFS
Inspector General of Forests
and Spl. Secretary

Preface

Of late, the concepts on forest management have been changing not only in India but the world over. The need for switching over from the timber-dominated forest management to the MFP/NTFP-oriented need-based sustainable forest management has been necessitated by the diminishing timber resources and consequent regulations imposed there upon, along with the quest for alternative sources of materials and money to meet the increasing needs of the growing population for their subsistence needs and socio-economic development. It has been observed during the past decade that with the increasing pressures of survival, the people look upon forests for short-term profitability, rather than waiting for years for the wood/timber and this attitude has certainly paved the way for promotion of Minor Forest Products (MFPs) for not only obtaining increased revenues, but also providing gainful employment and new opportunities for entrepreneurship. Besides fuel and timber, MFPs/NTFPs basically provide the world, the vital forest resources such as foods, medicines, essential oils, spices, resins, gums, latex, fibre and flosses, bamboos and canes etc. supported by other benefits and services leading to biodiversity-maintenance and ecosystem-conservation. They also play a vital role in providing sustenance and improving the quality of life of forest dependent communities including tribals and villagers who are generally disadvantaged groups of people. There is therefore, an increasing quest for meeting subsistence needs and sustainable development but available information is inadequate for appropriate extraction and utilization of minor forest produce. This calls for pooling up diverse and scattered information in an organised manner which may offer guidelines for different management regimes for sustainability and increased productivity.

An initiative has therefore been taken as a first step, to mobilise the information on various aspects of forest management in the book entitled **“Management of Minor Forest Produce for Sustainability”** spread over eleven sections, as no such information has yet been pooled-up. The Centre of Minor Forest Products is indeed indebted to the various eminent researchers, foresters and entrepreneurs for making valuable contributions to this book. Support offered by all of them since the creation of the Centre of M F P at Dehra Dun in 1991, both on our first call for an International Seminar on **“MFP in Forestry”** held from 17–18th April, 1993 followed by another International Seminar on **“Management of MFP”** from 13-15th November, 1994 has been very encouraging and we have no words to express our deep sense of gratitude to

them for the various papers and ideas contributed by them. It was conceived to knit the various papers of the latter Seminar according to the various subjects related to forest management and edit them in the form of this book. Help rendered in editing by Dr. B K Gupta, Reader in Botany, Editor of Journal of NTFP and other Journals and Dr. Abha Sharma, Research Associate of our centre of MFP, is gratefully acknowledged. Encouragement, technical and financial support received by the Centre of Minor Forest Products from various quarters is gratefully acknowledged, in particular the financial support for a project funded by the Ford Foundation and the sponsorships from the Ford Foundation, the Food & Agriculture Organisation (FAO), the Swedish International Development Authority (SIDA) and the John D and Catherine T MacArthur Foundation for organising the International Seminar on "Management of MFP".

The pioneering efforts of the Centre of Minor Forest Products, Dehra Dun in motivating the forest managers for MFP-oriented need based sustainable forest management were substantiated by the Food and Agriculture Organisation who organised the Regional Expert Consultation on Non-wood Forest Products at FAO, Regional Office, Bangkok, during 28th November–2nd December, 1994 followed by the International Expert Consultation at Yogyakarta, Indonesia from 17–27th January, 1995. Although I was invited to attend both the events from India on behalf of the Centre of Minor forest Products, Dehra Dun, I could participate only at Bangkok, while a "Basic Issues Manual on MFP", by Dr. Shiva was submitted for the consultation in Indonesia.

This book is likely to be the first of its kind which highlights the various strategies put into practice in implementing MFP/NTFP-oriented forest management. The outcomes of these initiatives may well lead the forest managers to develop an integrated resource management plan (IRMP) for establishing an equilibrium between utilisation and conservation. Such planning will ameliorate the lot of the disadvantaged groups of people including the women folk through gainful employment and income generation by sharing of usufructs. The sharing of benefits from the natural resources and participatory management will ensure socio-economic and industrial development within the country and handsome foreign exchange earnings through the export of minor forest produce which may be surplus after internal use.

In the modern trends of forestry management, it has been stressed by the Food and Agriculture Organisation (FAO) and the Centre of Minor Forest Products that NTFP considerations should be integrated into the mainstream of forest management and planning with a wide range of forest management project activities. It is also urged that forest management agencies should begin a process that will lead to greater emphasis on NTFPs in forest management. This book entitled "Management of MFP for Sustainability" discusses the various

opportunities for utilisation and the challenges of management thrown out to the resource managers and users to sustainably tap the invaluable potential of MFPs. Taking the lead, various institutions, both government and non-government have made quite a few management initiatives and set the ball rolling for MFP/NTFP-oriented need based sustainable forest management. *Participatory or Joint Forest Management*, *Nistar*, *social equity*, *MFP inventory* and *information management (MFP Database)*, *financial institutional interventions* for support of MFP activities etc, are all steps in this direction. Treading this path, we may draw benefits from the natural resources and also save them for our progeny.

Centre of MFP, Dehradun
October, 1995

M P SHIVA

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Introduction to Forest Management: Recent Trends

M.P. Shiva

Management is inextricably entwined with decisions of policy. Management of any enterprise embraces three main interlinked functions viz , settlement of purposes and main policy to be pursued, the consequent planning and organisation of activities and the conduct and control of operations (Osmaston, 1968) Management is also involved in choosing between two or more courses of possible action

Four main peculiarities in forestry are

- the length of time taken to make its products
- the identity of the manufacturing plant and the end product itself,
- the multiple and varied use of forests and
- the extent, topography and accessibility of land use

Technical ramifications of forestry are wide, dealing with biological sciences, Physical sciences, sociological sciences, land use and technology each with various components as indicated below

I BIOLOGICAL SCIENCES Plant morphology, Plant physiology, Plant taxonomy, Ecology, Geology, Pedology, Hydrology, Entomology, Plant pathology, Silviculture, Wood anatomy, Genetics

II PHYSICAL SCIENCES· Engineering, Survey and mensuration, Statistics, Research methods

III SOCIOLOGICAL SCIENCES Economics, Finance and accounting, Marketing, Social and labour relations, Law, Work study

IV LAND USE SCIENCES Grazing and pasture, Recreation, Wild life, Landscapes design, Water supplies

V TECHNOLOGY SCIENCES Logging, Sawmilling, Wood seasoning and preservation, Fire control, Mechanics, Road construction

Forest management deals with the practical application of the scientific, technical and economic principles of forestry. This technical definition is conceptualised and conveyed in different styles based on various objectives in mind Some say that the forest management deals with functions relating to the organisation of a forest property and maintenance of the same by executing various operations in time at various places, necessary for the conservation and

controlled harvesting of the forest, with adequate improvement of the forest areas. While forest management is also referred by the Society of American Foresters (SAF) to the application of business methods and technical forestry principles to the operation of a forest property.

The above mentioned views, highlight the varied nature of forest management which is concerned with the task of building, putting and keeping in order a forest business. The terminology of forest management was coined with a definite objective of mainly producing wood for timber and other industrial raw material while the minor forest products obtained from leaves, stem, bark, flowers, fruits, roots were considered as the subsidiary products. The management of forest involved three main functions viz.,

- a Control of composition and structure of the growing stock
- b Harvesting and marketing of forest produce
- c Administration of forest property and personnel

The above three tasks encompass the different activities based on the above concepts. India's first forest policy was enunciated in 1894 which was later revised in 1952 after independence. Later, the need for revision of the forest policy was felt and the National Commission on Agriculture (NCA) was constituted in 1970 and the final report emerged in 1976. Environmental conservation, production of timber for defence communication and domestic needs and social implications to meet the needs of the community for recreation, agriculture, timber, fuel-wood and regulated grazing for rural people were the main features of this report.

Based on the above concepts, plan of operations for the management of forest are being prepared in the form of documents called the "Working Plans". The essence of these working plans is to obtain sustained yield of the material that a forest can yield annually or periodically in perpetuity. The working plan gives a full account of the physical factors of the locality, composition of the forest, describes the past history, reviews past management, furnishes statistical data and lays down silvicultural management of the various types of forest.

With the changing trends in utilisation patterns and versatile demand, the National Forest Policy was revised and again enunciated in December, 1988. The basic objectives that should govern the National Forest Policy are summarised below.

- Maintenance of environmental stability through preservation and where necessary, restoration of the ecological balance that has been adversely disturbed by serious depletion of the forests of the country.
- Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of flora and fauna, which represent the remarkable biological diversity and genetic resources of the country.

- Checking soil erosion and denudation in the catchment areas of rivers, lakes, reservoirs in the interest of soil and water conservation, for mitigating floods and droughts and for the retardation of silation of reservoirs.
- Checking the extension of sand-dunes in the desert areas of Rajasthan and along the coastal tracts
- Increasing substantially the forest/tree cover in the country through massive afforestation and social forestry programmes, especially on all denuded, degraded and unproductive lands
- Meeting the requirements of fuelwood, fodder, minor forest produce and small timber of the rural and tribal populations
- Increasing the productivity of forests to meet essential national needs.
- Encouraging efficient utilisation of forest produce and maximising substitution of wood
- Creating a massive people's movement with the involvement of women, for achieving these objectives and to minimise pressure on existing forests

The essentials of Forest Management indicated in the National Forest Policy, 1988 are reproduced as below

- i Existing forests and forest lands should be fully protected and their productivity improved Forest and vegetal cover should be increased rapidly on hill slopes, in catchment areas of rivers, lakes and reservoirs and ocean shores and on semi-arid, arid and desert tracts
- ii Diversion of good and productive agricultural lands to forestry should be discouraged in view of the need for increased food production
- iii For the conservation of total biological diversity, the network of national parks, sanctuaries, biosphere reserves and other protected areas should be strengthened and extended adequately
- iv Provision of sufficient fodder, fuel and pasture, specially in areas adjoining forest, is necessary in order to prevent depletion of forests beyond the sustainable limit Since fuelwood continues to be the predominant source of energy in rural areas, the programme of afforestation should be intensified with special emphasis on augmenting fuelwood production to meet the requirement of the rural people
- v Minor forest produce provides sustenance to tribal population and to other communities residing in and around the forests Such produce should be protected, improved and their production enhanced with due regard to generation of employment and income.

In this context the following programmes for MFP development were envisaged for ameliorating the lot of Village and forest dwellers including tribals as indicated below

- i Safe guarding of existing resources by proper scientific methods of exploitation
- ii. Replenish the dwindled stock by proper methods of cultivation, harvesting, grading, processing to fetch better returns.
- iii. Organise marketing and trade to ensure adequate wages to the tribals
- iv. Establishment of small/cottage industries near their dwelling places.
- v Establishment of State Forest Development Corporations and Tribal Areas Development Societies and Federations and Tribal Cooperative Marketing Development Federation of India (TRIFED), of the Ministry of Welfare, Govt of India.
- vi Educating on various aspects of MFP exploitation and furnishing latest development as a result of research for adoption in the field
- vii Popularising social forestry and agro-forestry programme for obtaining adequate gains.
- viii Ensuring associations of the tribals with large-scale plantation giving rights on the tree and usufructs to them

It was rather unfortunate that the minor forest products did not receive adequate attention in the forest management till the seventh five year plan. However, the relevance of forest based economy with respect to economic development of tribals was realised during the seventh five year plan and during the preparation of National Forest Policy of 1988, stress was laid on MFP development as an essential item of forest management. It was recommended that special attention may be paid for protection, regeneration and optimum collection of minor forest produce, while strengthening institutional arrangement for the marketing of such produce. Tribal Cooperative Marketing Development Federation of India Ltd (TRIFED) was also, formed during 1987 by the Ministry of Welfare, Govt of India for the uplift of the tribals.

Soon after the enunciation of the revised National Forest Policy in 1988, new approaches to the forest management drew the attention of the foresters in India. Although the Social Forestry Programmes had commenced earlier, due focus on MFPs was accorded only after 1988. Accordingly, various land husbandry programmes were launched and the activities within the social forestry programmes reoriented and geared-up

With the changing attitudes and the needs of the times, the Govt. of India, notification in 1990 to preserve the forests with the help and participation of the people, organised in village level committees followed suit. The concept was termed as Joint Forest Management or JFM. Heralding a reversal in approach i.e. protecting forests from the people, JFM now caters to the needs of forest dwellers and the local people through an increased supply of goods desired by them. It essentially necessitates the sharing of the management and protection of

forests with forest dwellers and the tribals. So far only 14 states of India have responded and implemented the JFM approach

Owing to the rapid urbanisation, industrialisation and population growth, all the policy makers in the world rose to the occasion and organised an earth summit in Rio-de-Janeiro called the United Nations Conference on Environment and Development (UNCED) held in June, 1992 Chapter 11 of Agenda 21 relates to combating deforestation and the Non-legally binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests (generally referred to as the "Forest Principles")

Since then, great stress has been laid on environmental management with which is linked the maintenance of biodiversity and conservation of eco-system. Environmental management raises extremely complicated issues which require accurate knowledge base of the physical interactions in nature and a constant effort to reach acceptable and tenable trade off between the present and the future needs. The objective of the environmental management may differ from one society to another. For those countries which are heading towards industrialisation, where everyone is well-fed, the approach is more to secure the future, while, for developing countries where poverty is predominant the purpose of environmental management is to secure more for the present (Agarwal, 1992). It should, therefore, be endeavoured to meet the needs of the poor for fuelwood, fodder, small-timber and a large number of minor forest produce which should be able to meet the subsistence needs as well as provide avenues for employment and income generation at their door-steps. Although, in the 1988 policy, maintenance of environmental stability was emphasised, increasing the productivity of the forest to meet the essential wood requirements was also included as a basic objective. The policy also stressed that growing demand for fuelwood should also be given due weightage in production forestry in addition to meeting the industrial demand. But owing to the heavy exploitation of wood for timber, felling of trees had to be restricted and banned in certain areas. With this strategy, the importance of MFPs emerged as the significant source of revenue particularly in such an era when the demand for minor forest produce (MFP) which are also called Non-Timber forest Products (NTFP) or Non-Wood Forest Products (NWFP) has grown tremendously to meet the requirement of the people locally as well as for small and big industries based on non-timber forest products. Thus, emerged a changed scenario for forest management which encompasses diversified aspects based on the concepts discussed here. The papers published in this book by Chandrasekharan, Saxena and Prasad have offered their valuable views for the implementation of a changed forest management.

Now is the time to switch-over from the **Timber-Dominated Forest Management to the MFP-oriented need-based sustainable forest management**

and the various activities should be resolved around this nucleus. This is now a global issue and the essence of forest management should be borne in mind to fulfill the requirements of different components.

For meeting multiple uses obtainable from forests, the management approach should also be a multi-pronged approach and the various components are to be tackled with different management systems integrated into one.

Managers are now focussing their attention to integrated resource management plans (IRMP) designed to enhance the supply of food and non-wood products called the minor forest produce, with the object of conserving and managing the floral and faunal resources. It is also aimed to study the potential for mobilising and assisting people in boosting income and employment generating activities in the area, with particular focus on disadvantaged groups of people, to develop the tourism and recreational potential, to enhance the protective roles of forest against soil erosion, cyclones and tidal surges through inter-departmental coordination by augmenting the capability of the staff and providing physical facilities. The IRMP involves spatial and temporal changes and the effect of different treatments on the long-run sustainable forest management, thus, achieving the targets of socio-economic development, biodiversity maintenance and ecosystem conservation with multi-dimensional approaches as conveyed in the **flow chart** Components of Forest Management—A Global Issue (Fig 1).

Bearing the above objectives in mind, the Centre of Minor Forest Products organised an International Seminar on “Management of Minor Forest Produce” during 13–15th November, 1994. The Seminar was held in five sessions to cover the various aspects of MFP, NTFP-oriented forest management indicated below

- i. NTFP-oriented management and silvicultural techniques.
- ii. Scrutiny of current policies with emphasis on NTFP-management
- iii. Current use and distribution/availability of different NTFP species
- iv. Economics of cultivation of NTFP species and harvesting
- v. Value-addition perspectives for NTFPs

Some useful recommendations emerged during the seminar are appended in the Appendix-I. About 110 papers were received from various eminent authors from India and abroad, out of which 67 papers are being published in this book while grouping the papers into eleven sections according to the subject to which they relate.

Since, the MFPs have gained considerable importance during recent years, the Food and Agriculture Organisation also organised Regional Expert Consultation on Non-Wood Forest Products - Social, Economic and cultural dimensions, from 28th November–2nd December, 1994 at FAO-RAPA Bangkok, which was attended by the Centre of Minor Forest Products as a representative

COMPONENTS OF FOREST MANAGEMENT - A GLOBAL ISSUE

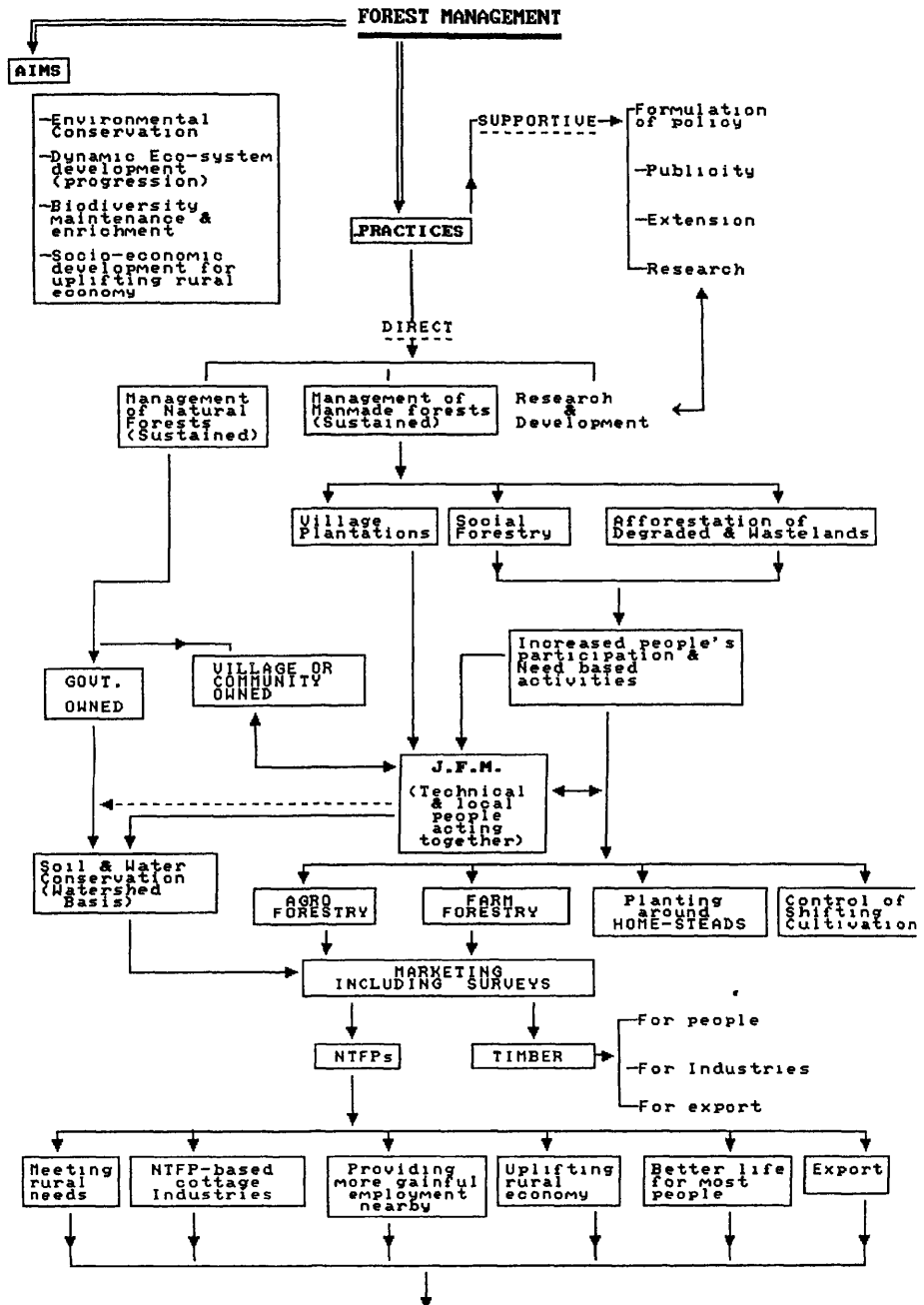


Fig 1 MFP/NTFP oriented need-based management for the benefit of the nation

from India. Participants came from more than 20 countries in the Asia-Pacific region. Resource specialists from North America, Europe and Africa brought valuable perspectives from other parts of the world to the meeting. Participation by women, NGO representatives and non-foresters was particularly strong.

Marketing and trade specialists provided advice to consultation participants on how to improve linkages between rural producers of non-wood forest products and consumers through efficient and viable market mechanisms. Similarly, legal specialists provided guidance on ways to protect local peoples' rights of access to increasingly valuable non-wood forest resources.

Despite the diversity of the meeting participants, the group developed a surprisingly solid consensus on the need for local community control and management of non-wood forest resources. This was perhaps the single most important conclusion and agreement emerging from the consultation.

Based on resource papers, technical presentations, working group sessions, and general discussions, the consultation made several recommendations given in Appendix II (Anon, 1994).

FAO continued its strong focus on the development of non-wood forest products (NWFPs) by organising an International Expert Consultation on Non-Wood Forest Products, convened in Yogyakarta, Indonesia from 17–27 January, 1995. The consultation was attended by 56 NWFP specialists and 42 observers from 44 countries and organisations.

The objectives of the consultation were to

- Obtain better insight into the problems and issues to be addressed and the potentials for developing non-wood forest products in an environmentally sound manner;
- identify and propose priorities for action in promoting development of non-wood forest products, taking into consideration their socio-economic, technological, environmental and institutional dimensions;
- develop, in draft form, a broad strategy framework and related guidelines for sustainable development of non-wood forest products and
- provide suggestions/recommendations for action to be pursued at the international level to support national efforts on non-wood forest products.

The results and recommendations of the global expert consultation are given in Appendix III (Anon, 1995).

It is hoped that all the endeavours made towards implementation of MFP-oriented sustainable forest management would go a long way in successfully shaping the future of the forest management. Various papers in this book would offer guidelines to all those who are involved in the process of forest management, may be the policy makers or foresters and a large number of other groups involved in the development of forest. There appears to be a warm-ray of hope in this direction to enable the people to see the dawn of the day.

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Appendix I

RECOMMENDATIONS OF THE INTERNATIONAL SEMINAR ON “MANAGEMENT OF MFP” (13th–15th November, 1994, Dehra Dun, India)

**Organised by the Centre of Minor Forest Products,
Indirapuram, P.O. Majra, Dehra Dun 248171**

SESSION I: NTFP-ORIENTED MANAGEMENT AND SILVICULTURE TECHNIQUES

Realizing that:

- (I) there is a general decline in productivity and extinction of species due to biotic pressure, resulting in ecosystem disturbance and,
- (II) that cooperation of the surrounding population is essential to the maintenance of the ecosystem before steps for rehabilitation and increasing productivity can be initiated, it is recommended that,
 - a Propagation methods and Silvicultural practices to boost production from selected NTFP species (preferably indigenous) of great value, should be standardised in the different agro-ecological zones
 - b Models of mixed species in tiered plantation may be developed for agroforestry produces and raising homesteads plantations to augment production to ensure sustainability of the hitherto over-exploited forests
 - c Conservation of germplasm of NTFP species may be ensured to save endangered or threatened species by creating germ-pools and nurseries from selected plus trees and evolving superior clones/streams for future planting.
 - d Appropriate management practices with respect to existing forests may be so reoriented that;
 - (1) Preference may be given to meeting needs of the forest-dependent communities for subsistence and also for augmenting NTFP resources for socio-economic development. Timber should be considered as a by-product whereas usufruct (which provide subsistence support to the villagers) should be given greater attention both with regard to silviculture and management NTFP collections should be regulated with timber harvesting operations. A system of harvesting without damaging the eco-system should be developed for adoption
 - (11) (a) Technologies for propagation must be simple and locally appropriate so as to make them acceptable and adoptable in the rural areas

- (b) Available wastelands and lands wherever available, should be harnessed for further afforestation for the mutual benefit of the entrepreneur and the State
- e It is essential to have a mechanism to disseminate research results for field application. Hence, not only a database for all locally important NTFP species should be built up, but also, extension programmes should be chalked out so that results can easily be permeated into the minds of the lay people, specially the villagers.
- f Institutional aspects to consolidate and strengthen the Infra-structure and improve efficiency of working, need more attention
 - (a) Forest corporations should come forward to control marketing operations and consider announcing support prices to help tribals. They should also do market research and develop diversified objects (derivatives with value addition) for providing sustained and increased income to the forest-dependent communities
 - (b) NGOs may also be involved, government agencies should only act as a catalyst or facilitators.
- g Case Studies should be developed in different agro-climatic zones to understand local problems and innovate solutions to ensure success of programmes for sustained production and supply of NTFPs from the regions concerned.

SESSION II: SCRUTINY OF CURRENT POLICIES WITH EMPHASIS ON NTFP-MANAGEMENT

Presently there is a contradiction in the provisions of national policy, Acts and various circulars of government and executive orders of various departments. It is, therefore, recommended that

- I Policy should be framed with respect to the people's considerations. Act should be formulated by giving due consideration to the policies. Circulars should be released according to policy and Acts in force; previous circulars and executive orders should be revised keeping in view all the above considerations.
- II Forest Policy may be analysed with emphasis on NTFPs and may be reviewed to provide direct benefits to the tribals and forest-dependent communities, who may be involved from the very beginning, in addition to technical and scientific people. The bankers may also be included at the inception stage.
- III It is recommended that the adjoining States should consult each other while making State forest policies, Acts etc.

- IV. The silviculture and harvesting technologies and also transport facilities should be developed for fulfilling the wishes and demands of people. System should be devised so that concepts in management of forest emerge from the grass-root level for sustained production and thereby the ideas travel from bottom upwards rather than top downward. In other words, for a State or a nation, the starting point should be at micro-level.
- V. There should be proper and uniform institutional arrangements at various levels, so that above points can be implemented. Such nodal agencies should be created at local and State levels where informations converge and at the same time they diverge.

In this context, it is recommended that the "Centre of Minor Forest Products" should be recognised as a Nodal Agency on National level in respect of Minor Forest Products and their various aspects.

- VI. All dis-incentives in the realm of collection, transport and sale (subject to scientific working) at the primary collectors' level should be done away with. Similarly at the secondary level (manufacturing and diversification for value addition), legal and administrative handicaps should be dispensed with.
- VII. In many States, NTFP items have been put under State trading. This system had been in vogue of past several years. It is recommended that state-trading should be reviewed to find out its impact on the tribals and the rural population vis-a-vis the forest resources. Quantification of real benefits and returns need a close study.
- VIII. There should be some uniform policy in the State and at National level for pricing and standardisation of measurement units of each NTFP—item specially at the primary collector's level to ensure that the primary collector is adequately paid for the produce collected by him.
- IX. In order to ensure greater awareness amongst the people at large, it is considered desirable to impart short lessons on various non-timber forest products at various schools/college level. The National Agency may suggest a proper syllabus in this regard.

SESSION III: CURRENT USE AND DISTRIBUTION/AVAILABILITY OF DIFFERENT NTFP SPECIES

Over the years, management of the forests has remained geared to production of timber, although lot of non-timber forest products are very important for the socio-economic upliftment of the rural poor. Their collection, processing and marketing provide enormous employment opportunities to millions of tribals and rural communities particularly during the lean months of agriculture. Realizing the great potential and contribution of NTFPs for the common man, it is considered necessary to recommend that

- I. (a) A quick survey should be carried out in each State to assess the present status of NTFPs with regard to the availability and distribution of each of the economically useful NTFP species. Information should be made available in a computerised data base on NTFPs.
- (b) Sustainable extraction levels of NTFPs should be determined, particularly where harvesting is destructive (e.g. bark and root) or where regeneration is critical.
- (c) Under-appreciated plants (so far considered as weeds) should be investigated for their potential utility and consideration should be given to their sustainable harvesting and management.
- (d) Quantitative assessment and information collection on major forest products (usufructs) should be complimentary to any analysis of NTFPs.
- II With increasing extraction of NTFPs and their use particularly medicinal plants, consideration should be given to *ex-situ* cultivation to relieve pressure on wild resources. *In-situ* cultivation of NTFPs should consider multistorey intercropping patterns and drawn on traditional knowledge.
- III. Successful *in-situ* conservation of NTFPs should actively involve local people in order to ensure sustainable use and management, considering traditional use rights and historical patterns of use (e.g. Nistar).
- IV Biologically sustainable use of NTFPs should consider multipurpose objectives and include new and innovative silvicultural methods which should involve local communities in management of institutional, technical decision making and implementation arenas.
- V The needs of the industry and other end uses should be understood by the producers in order to effectively link the two.
- VI. NTFPs should be integrated in the Tribal Development Programmes, being planned or under implementation.
- VII Efforts should be made to provide value addition by simple means at the village level or Forests Management Committee level through improved semi-processing and processing.
- VIII More market studies need to be undertaken to find out alternative institutional options for efficient and equitable marketing.
- IX Forestry legislation should be reviewed in the light of NTFP needs, especially on the use of commercial cultivation of NTFPs.
- X While NTFP databases are extensively important, there is need for continued collaboration among other database projects to avoid duplication of efforts. Where possible, internationally accepted data standards/format for recording information should be considered in NTFP databases to allow ease of data exchange between databases.

- XI. (a) Research, management and benefit-sharing related to NTFPs should be carefully scrutinized to assess the differential impacts according to gender, social and economic status.
- (b) As an intercrop in agroforestry, suitable NTFP species should be tried, based mostly on local experiences
- (c) In thinning, preference needs to be given to economically important NTFP species on which livelihood of the people is dependent. NTFP species should be retained as mother trees in order to augment their supplies in future.
- (d) In shifting cultivation areas, cultivation of Multi-bamboos (*Melacona* sp.) should be encouraged
- (e) Collection of *Bauhinia vahlii* leaves should be enlarged as it is a profitable local industry (sale as platters)
- (f) The JFM approach is commended for effecting sustained use of NTFP resources. Where possible, community forest management groups should be the focus for NTFPs forest management, collection and marketing
- (g) Management of NTFP must be biologically sustainable, economically and institutionally acceptable. This requires an interdisciplinary approach, involving all stake-holders from local community groups, private producers, traders, industry, researches and managers

SESSION IV: ECONOMICS OF NTFP CULTIVATION AND HARVESTING

Realizing that very little data exists regarding economics of cultivation of NTFPs and due to lack of this knowledge, the middlemen enjoy the lion's share while the primary collector/producer gets a very low return for his efforts and there is no prescribed norm for equitable sharing of benefits between the various user agencies, it was recommended that:

- I Case Studies should be conducted to document information on the economics of the cultivation of each NTFP species, specially for those which have Industrial utility (e.g. *Tendu leaf*, *Kewada* and other essential oil bearing species etc)
- II Economically viable models for intercropping NTFP species in land husbandry should be evolved by forest corporations by undertaking field trials. Silviculture techniques of NTFP species hitherto unknown should be standardised. Newer technologies of propagation like Tissue culture should also be employed
- III Control measures (biological, chemical or mechanical) for reducing deterioration in quality, whether due to insects/pests, fungus or poor storage be devised

- IV. Quantification of value-added products required at different stages should be recorded along with appropriate modern technology to effect the same for boosting the income of the local people
- V Available information with the tribals (acquired by them through heritage) should be documented and updated so that full benefit of growing, extracting and processing natural resources (specially for medicinal plants) could be utilized by user groups
- VI Herbal gardens should be developed nearer to government centres, or NGOs or urban centres to augment resources of plants for various purposes including medicinal use and thus reducing the pressure on limited wild resources.
- VII Role of government agencies (Corporations etc.) should be analysed to see if government intervention has provided positive relief Institutional support to provide information on markets and marketing, transport and to solve problems in transit is necessary. Co-operatives should be formed for efficiency in management and equitable distribution of profits Help of NGOs should be obtained in this regard by Forest and Rural Departments of the Centre and State Governments.
- VIII Community involvement should be ensured for participatory management to support in proper decision-making with regard to rights and concessions and sharing of benefits

SESSION V: VALUE ADDITION PERSPECTIVES FOR NTFPs

Realizing the importance of providing increased benefits to the rural poor and the entrepreneurs involved in NTFP trade to improve the quality of their life, it was recommended that:-

- I Quality control standards of NTFPs should be laid down through Bureau of Indian Standards (BSI), New Delhi, Quality consciousness has to be popularised both in the planning as well as marketing stage
- II Medicinal and aromatic extracts should be authenticated through extensive research on modern lines and standardisations formulated through BSI, New Delhi
- III Improved methods of utilisation should be developed taking care that the active principles/ingredients are not destroyed in the process (e.g. in case of root and bark extraction)
Linkages in marketing should be developed for better returns through value-addition and pricing policy or open auction
- IV Human resource development is necessary and is a prerequisite to introduction of improved technologies Training on proper methods of identification, collection at right stage, preservation, packaging, storage, processing and transport must be ensured.

- V. Ecological/Environmental/Social/Institutional compatability should be ensured based on National/Govt. policies and community participation. Agro-Techno-Managerial Innovations like village level seed production centres, farmer's nursery for supply of planting material, plantation techniques of mixed NTFP species in tiers for land husbandry at appropriate spacings as in Tasar silk rearing farms, should be given greater care for including decentralised working and developing of various linkages.
- VI Financial aspect (providing loans etc) should be given due attention to ensure quick and timely flow of funds through co-operatives and banks, when required by the chain of people involved

Appendix II

RECOMMENDATIONS OF THE REGIONAL EXPERT CONSULTATION ON NON-WOOD FOREST PRODUCTS: SOCIAL, ECONOMIC AND CULTURAL DIMENSIONS (28th November–2nd December, 1994, FAO/RAPA, Bangkok, Thailand)

Policy Recommendations

- 1 Wherever possible, communities should be given rights and authorities to protect and manage local resources by, and for, themselves
- 2 Countries and institutions should establish policies and enact laws that provide local communities with management capability (e.g., through training, information, and credit) and incentives for long-term sustainable management of non-wood forest products
- 3 Agencies with jurisdiction over, or financial interests in, forest resources, should promulgate mission statements and plans to proclaim and strengthen their commitment to stewardship of non-wood forest products and partnership with local resource users
- 4 For purposes of monitoring, regulating, and taxing, differentiation should be made between natural (collected) non-wood forest products and those which are planted or cultivated. Exploitation of natural non-wood forest should be carefully monitored and limited to sustainable levels. Propagation of endangered plants should be encouraged.
- 5 FAO should revisit Resolution No. 8 (1983) concerning the common heritage of genetic resources with a view toward ensuring that local knowledge and local efforts to conserve and develop non-wood forest products, especially medicinal plants, are appropriately valued and compensated

Management Recommendations

- 1 Non-wood forest product considerations should not be treated apart from broader forest management activities, but rather should be integrated with a wide range of projects and activities
- 2 Forest management agencies should begin a process that will lead to greater emphasis on non-wood forest products in forest management strategies. In some countries this process will be slow, involving task forces, consultations, and research. In other countries the process may depend upon decisions by a relatively small number of individuals and can be accomplished quickly. Process aside, the objective should be the integration of non-wood forest products into mainstream forest management and planning.

- 3 Management responsibilities of forestry professionals should be expanded to include human ecology and conservation. Financial compensation and incentives should be increased for those professionals who successfully promote biodiversity conservation and the sustainable development of non-wood forest products.
- 4 Decentralized processing of non-wood forest products should be encouraged to enhance the likelihood of a higher percentage of economic benefits staying within local communities.
- 5 Communities, local people's organizations, and NGO's should be involved in designing and implementing strategies for non-wood forest product development. Local organizations should be strengthened where necessary to enhance local participation.

Training Recommendations

- 1 Training of foresters and field forestry workers should be expanded to provide greater emphasis to non-wood forest resources and their production, utilization, and marketing.
- 2 The curricula in forestry schools and other educational institutions at all levels need to be expanded to include more interdisciplinary perspectives, including environmental stewardship, local equity in resource management, marketing, financial management, appropriate technology, and coalition building.
- 3 Where local knowledge and experience [§] is inadequate, practical training should be provided to local growers, collectors, and processors of non-wood forest products to ensure sustainable and efficient use of the resources and to increase local income levels.

Research Recommendations

- 1 Research should emphasize case studies, especially those that identify and analyze the causes of success and failure in non-wood forest products development. Case studies are particularly needed in the areas of community management, production of non-wood forest products, forest dependency, sustainable utilization, equity, and benefit sharing in marketing. There is also a need to develop case studies that describe and analyze the marketing channels from collectors/producers to consumers.
- 2 Other specific research should be conducted on
 - the supply and demand of non-wood forest resources, currently and in the future,
 - indigenous systems of local knowledge and resource management,

- the connection between tenurial security and the sustainable development of non-wood forest products,
- the role of gender in resource management, including areas with matrilineal customs and property rights,
- appropriate technologies for non-wood forest products harvest, use, and processing;
- the existence and effects of professional biases and inaccurate stereotypes, especially those concerning local resource users.

Information Needs/Recommendations

- 1 Comprehensive inventories of non-wood forest resources and assessments of their uses are lacking for most non-wood forest products; such inventories are sorely needed.
- 2 Surveys and analyses of the degree and extent of the subsistence and local uses of non-wood forest products should be conducted prior to encouraging more intensive commercial exploitation
- 3 Marketing analyses that follow specific non-wood forest products from collection to final consumer are needed for a variety of products in each country.
- 4 Better linkages should be developed among the numerous networks and organizations already dealing with non-wood forest products
- 5 Producers, buyers, and consumers should be sensitized and made aware of the value of non-wood forest products and the issues related to their development and exploitation
- 6 FAO and other international organizations should gather, analyze, and distribute information concerning non-wood forest resources, collection, production, and marketing.

Appendix III

RESULTS AND RECOMMENDATIONS OF THE EXPERT CONSULTATION ON NON-WOOD FOREST PRODUCTS (17–27th January, 1995, Yogyakarta, Indonesia)

The Consultation emphasised the importance and major role of NWFPs for: meeting the needs of indigenous and rural communities for food, fodder, medicine, construction materials, fertiliser and a variety of other goods and services; supporting environmentally sound management of forest resources, providing income and employment to local communities, contributing to value addition through downstream processing and foreign exchange earnings.

The consultation discussed the following areas of concern definition and classification; socio-economic benefits, processing and marketing; resources management and environment, and institutional considerations

The Consultation underlined the need for managing NWFPs as part of total ecosystem, rational use of biodiversity including biodiversity inventories and information management, ensuring ‘eco-efficiency’, social equity and sustainability. These have to be achieved through rational policy measures and strategies, economic incentives, cost effective technology and community participation

The Consultation made recommendations addressed to government policy makers, international organisations, donor agencies, NGOs and financial services, in order to enhance socio-economic benefits of NWFPs, promote sustainable management and utilization of NWFPs, improve scientific knowledge, technology and skills relevant for developing NWFPs, develop appropriate policies and strategies to support development of NWFPs, improve and expand basic statistical information on production, value addition, and trade in NWFPs; establish networks for exchange of information; introduce rules and regulations to promote decentralisation of resource management through active community participation, establish other institutional mechanisms, including access to resources and credit, and strengthening research capabilities. The Consultation also identified priority areas for research and development of NWFPs

The Consultation, in its recommendations, specifically requested FAO to develop and provide guidelines for sustainable management of NWFPs, promote establishment of information networks on NWFPs, compile a directory of available data bases, as well as of institutions working on NWFPs, draft a policy framework on NWFPs to serve as a model to be adapted by countries, collaborate with relevant agencies/institutions in addressing specific trade issues such as of information about chemical and biological diversity of forests, develop a system of classification of NWFPs, harmonised with the existing international systems such as International Standard Industrial Classification (ISIC) and Standard International Trade Classification (SITC), in collaboration with the

UN Statistical Office. It further requested international funding and technical assistance to support new initiatives in the area of NWFPs.

The representative of the Government of Indonesia, in his remarks at the closing ceremony, indicated interest to establish an international centre for information exchange on NWFPs in Bogor and called for support to the initiative.

Section 1

POLICIES ON NTFP MANAGEMENT

Non-wood Forest Products—A Global View of Potentials and Challenges

C. Chandrasekharan

INTRODUCTION

We are all aware that forests provide wood and non-wood products. They could be harvested separately, simultaneously or sequentially. They are not mutually exclusive. Their fortunes are closely linked.

Depending on situations, the overall importance of wood and non-wood products would vary, in terms of monetary value and/or the number of people benefitted.

Wood, being composed of lignified, water conducting, strengthening and storage tissues, is comparatively homogeneous. Range of wood products are limited compared to non-wood forest products.

Non-wood forest products include all goods of biological origin other than wood in all its forms, as well as services derived from forests or any land under similar use. They may be of plant or animal origin. Most of the non-wood forest products are derived from non-woody plants, including lower organisms and non-wood parts of woody plants/trees.

Non-wood forest products include a number of goods under the broad categories of food and food additives, fodder, fibre and flosses, (biomass) fertilizer, herbal potions, phytochemicals and aroma chemicals, oils, latex, resins and other exudates, organic construction materials, decorative articles, and different kinds of animal products. They also include services such as grazing and recreation experiences. A large number of items of our everyday use such as medicines, perfumes, suntan lotions, nail polish, mouth wash, hair conditioners, toiletries, cheese, chewing gum, ice cream, soft drinks, juices, peanut butter, edible nuts, breakfast cereals, culinary herbs, canned fish, dairy deserts, fancy bags, decorative buttons, chess pieces, golf balls, paints, corrosion inhibitors, fungicides and a host of others, contain varying proportion of non-wood forest products.

ROLE AND IMPORTANCE

Non-wood forest products play a crucial role in the daily life and welfare of the rural population. Millions of people around the world, living in the vicinity of

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forests, subsist on these products. They provide opportunities for off-farm employment and income.

Non-wood forest products support processing industries. Small-scale units of these industries are amenable to be linked to central refining and further processing units. Many of the non-wood forest products are internationally traded commodities

Some eighty per cent of the population of the developing world depend on non-wood forest products for their primary health and nutritional needs. The global monetary value of plant-based pharmaceuticals in OECD countries by the year 2000 is estimated to reach 500 billion US dollars.

A study in the Iquitos Region of Peru has indicated that the present net value of plant resource in a site researched was equal to 9000 US dollars, 88.2 per cent if it was accountable to fruit and latex products.

Non-wood forest products often are of a higher value per unit weight or volume. It has been reported that in some Brazilian forests, one tonne of non-wood products generates a monetary value equivalent to that of 25 tonnes of wood.

Some communities of Brazilian Amazon earn upto 960 US dollars of income per family from extraction of rubber and nuts from forests.

Some 50 million tribal people in India depend on non-wood forest products for meeting their subsistence consumption and income needs. Possibility of continuous income from non-wood forest products can provide a strong incentive to adopt it as a most important alternative to shifting cultivation in upland areas.

In many countries, non-wood forest products form the major or an important component of forest products exports.

Under natural conditions, non-wood forest products can be managed along with wood in an integrated manner thus increasing overall productivity. Controlled and regulated exploitation of non-wood products is fully compatible with the ecological and conservation functions of the forest. Some of them can also be grown as pure or mixed crops under agroforestry systems.

THE PARADOX

It is paradoxical that, in spite of their real and potential value, most non-wood forest products remain grouped as *minor* products of forests. Some, of course, have moved upto the status of intensively managed agricultural or horticultural crop, due to their special attributes. This minor status resulted in benign neglect of non-wood forest products.

Why have these products been neglected so far? What are the constraints affecting their development?

The constraints are several.

Most non-wood forest products are often associated with traditional uses that

are not widely known and/or they are linked to the problem of poverty and subsistence.

Transactions related to non-wood forest products largely takes place in households and small-scale units, mostly outside the established marketing systems/channels, thus forming part of unorganized, informal sector. Operations are often seasonal. For these reasons, they are often overlooked by planners

Timber-orientation of forestry profession, and the bias of planners in favour of large-scale enterprises, often leave non-wood forest products at a disadvantage. Their production, at best, was considered incidental or subsidiary.

Sustainable management of non-wood forest products, especially of those occurring among the biological richness and ecological diversity of natural forests is extremely complex. This has resulted in its being left out from management prescriptions, and preference being given to comparatively easier timber management.

A wrong perception still exists that forests which do not produce timber are of low or no value. In timber forests, non-timber plants are often treated as weeds. This causes conflicts in resource use between wood and non-wood products, and also between the concerned user groups.

All these constraints are capped by lack of knowledge about the potential of non-wood forest products to support sustainable and remunerative enterprises. Statistical information to underpin their importance is sorely lacking. We have only very limited information about their resource base. Being considered *minor* there was hardly any attention paid to it in terms of inventory, management, conservation and related research. Nor has the necessary skill base been developed.

Some of these constraints, in one way or other, are related to the characteristics of the products.

Non-wood forest products as a group is extremely heterogeneous, requiring a mix of different skills, technology and research support in their management.

Resources of these products are often dispersed and vary considerably in their concentration. This, to some extent, leads to their localized importance.

Knowledge on non-wood forest products to a significant extent is local, empirical and often linked to local culture. This makes information gathering or exchange more difficult.

There is also overlapping of uses and sources. Some product can be produced from different non-wood raw materials, and same non-wood raw materials can provide different products. This adds to the complexity of managing and utilizing the resource.

NEW AWARENESS

Recently, however, the significant environmental and economic roles of

non-wood forest products have come into focus through better understanding of their importance. The new market preference for natural products and emphasis on efficient and sustainable use of natural resources have helped this development. Consequently, there has been an increasing interest on non-wood forest products. They received notable attention at the UNCED 1992

In most cases, this new interest is yet to be transformed into commensurate and consistent action. There is need to correct the technological and institutional inadequacies in order to increasingly realize the socio-economic potentials on non-wood forest products and to bring them into the main stream of modern economies, while retaining their accessibility to traditional societies.

ISSUES AND CHALLENGES

The core of all issues affecting non-wood forest products is that it is considered as *minor*. It is a fallacy. And the challenge is to remove that fallacy. This is a precondition to address other issues which emanate from the central issue.

Let us briefly look at the series of issues and related challenges

In Relation to Resource Development and Management

The future of non-wood forest products, in spite of their apparent scope and potential, would depend on the integrity and stability of the forest resources. Plants and animals providing non-wood forest products to a great extent represent the biological wealth and variety of forests. Their conservation is part of a much wider and fundamental concern, and is an investment in sustainable development.

The objectives of natural resource conservation and protection of biodiversity can be served at least partially by cultivation of species. Domestication of wild plants yielding non-wood products, involving their genetic improvement, and growing them under intensive cultivation practices is considered as a means of ensuring efficiency in production. It has been the experience that once a product achieves commercial importance, its supply from wild sources tends to be replaced by cultivated sources with a view to bringing production, quality and cost under control. Productivity of cultivated crops can be enhanced through improved agro-technology. Those domesticated species are dependant on regular infusion of germplasm from wild genetic reservoirs for improving their performance. It may, however, be noted that some species cannot be grown outside their forest habitat.

Sustainable use and management of forests has emerged as a high priority in the development agenda of nations. Non-wood forest products are seen by many as the key to the management of forest resources in a sustainable way.

Historically, the focus of wood as the principal product of forest is a

relatively recent development – a development which was fostered by industrial revolution. Return to a more balanced view of the variety of products, wood and non-wood, which can sustainably be removed from well-managed forests will be significant improvement.

Integrated multipurpose management of forests is highly demanding on scientific knowledge and technology. It involves, in addition to inventory of wood resources, detailed investigation and prospecting of non-wood forest resources for fibre, phytochemicals, aromatics, gums, resins, etc. Only a small percentage of species have been examined for their attributes and uses, e.g., pharmacological activity. Work involved in scientific screening of forest resources for valuable ingredients is enormous. These investigations have to consider the nature and extent of distribution of specific plant resources, their density of occurrence, their potential supply from wild sources, their suitability to be grown under multi-species environment (e.g. enrichment planting under natural forest cover and agroforestry) or under monoculture. Traditional knowledge and ethno-biology can contribute considerably for planning integrated development of the resources.

In-situ genetic conservation of areas with greatest number of plant varieties of known economic value, as well as of those with potential, should be part of integrated forest management. It may often be a compatible objective of management to allow controlled extraction of non-wood forest products from natural forests which are included as part of protected area systems, especially in the buffer zones of protected areas.

However, the lack of compatible forest management systems, combining ecological and economic prudence, suited to the various situations encountered do present serious problems. And, the situation poses many challenges as we still know very little about the stand dynamics, ecology and silvicultural requirements of many of the forest ecosystems, especially in the tropics.

– Harvesting of non-wood forest products, of both wild and cultivated sources, is different from wood harvest in terms of the use of tools and equipment, technology, pre-harvest preparations, post-harvest treatment and requirement of intermediate processing. It varies from collection of nuts and leaves to tapping of latex, harvesting of palm hearts, honey hunting, collection of mushroom, extraction of wax and collection of decorative plant materials.

Harvesting is a particularly weak link in the utilization of non-wood forest products due to the variety of tools, techniques and situations involved. The existing systems do not have adequate technological and management backup. Efforts are also not made, usually, to harmonize harvest of wood and non-wood products. Also its linkage to a chain of middleman and traders is not conducive to sustainable resource use.

– Post harvest care is poor in most cases, resulting in loss in quantitative and qualitative terms during transport and storage. Challenges involved in

rationalizing and improving harvesting systems and practices for non-wood forest products are considerable.

There is also some of the traditional dilemmas of balancing operational efficiency (cost of production) to considerations of conservation. Apart from technological improvements, it will call for new arrangements of access, ownership, control and management, and a clear understanding of the role of local people, management agencies, industry and governments.

In Relation to Rational Utilization

Non-wood forest products are consumed by people of varying social levels – from shifting cultivators and subsistence farmers to affluent urban populations. For many, non-wood forest products are the most important source of livelihood. Consumption takes place in the raw (immediately after harvest), semi-processed and processed forms. Forest fruits, herbal medicine, bamboo mats, turpentine, food additives and fragrances are indicative of the range. Use of some non-wood forest products are primarily local in nature. Some are over-used. Others suffer from lack of promotion. Some products meet bulk demand, others reach specific niches.

Range of variation in the level of processing of non-wood forest products is considerable. At one end of the spectrum, the processing involves only drying or preserving. At the other end are the highly processed, sophisticated consumer articles.

While primary and downstream processing of non-wood forest products add value to the material and provide local employment, in most developing country situations harvested products reach the market, local or foreign, either after some intermediate processing or primary processing.

Processing for local use generally takes place in units which are small, numerous, dispersed, financially weak, primitive in technology and managerially poorly served. They are low-return activities. Their survivability is low as they tend to be abandoned as wages rise or alternative opportunities arise.

Bigger establishments in developing countries either carry out primary processing for larger markets or for export. Some engage in secondary processing.

Non-wood forest products are an important source of foreign exchange for many countries. A recent FAO study identified 116 items of non-wood forest products as commercially important in international trade, considering the group of medicinal plants as one item.

Market-oriented downstream processing, for export markets, is highly specific on quality and stresses on reliability of supply. But due to the lack of technology, skilled manpower, management expertise, capital for investment and marketing arrangements, sophisticated or refined downstream processing is rarely done in most developing country situations, and often export is confined to primary products.

General quality standards for internationally-traded products are established by the International Organization for Standards. Quality and safety/sanitary regulations, including packaging standards, established by food and drug administrations and consumer protection groups of importing countries are often rigid in respect of items such as medicinal extracts, phytochemicals, food colorants and additives. Inability to meet the standards would normally lead to loss of market.

It is necessary to know the specific market needs as well as the product specifications and standards required, before venturing into export-oriented production. There is also need to link the production to a reliable and captive source of raw material supply. Although adding value locally is important, attempting to produce end-user commodities without adequate preparation or studies will be risky.

Apart from the technological and managerial deficiencies, an issue to be brought into focus is the distorted incentive system where huge projects are made by the trader middleman. In the absence of appropriate link between input sector and post-production sector, exacerbated by lack of market information, the cultivators, collectors and resource owners of non-wood forest products do not get a fair share of the value-added. In such a system, efficiency in resource management becomes a casualty.

There has been, over the years, an erosion of international market share of non-wood forest products. In many instances, cheaper substitutes have been developed. Prices have, as a result, fallen. The vulnerability of non-wood forest products have been attributed to unstable supply, inconsistent quality and unreliability of their source.

If technology is improved, collection and trade channels rationalized and made efficient, and appropriate processing facilities developed in the producing countries, it will undoubtedly be possible to effect a positive change in the situation. It is necessary also to develop new products and new uses for known products, with a clear market orientation.

One aspect which gives some indication about the possibility of controlling costs and improving economic efficiency is the vast difference between the price paid to the collector or local producer and that obtained for it in the market. It has been reported that for several items of non-wood forest products the local producer receives only a negligible portion of the price for it in the developed country markets.

As an example, it was noted that one crude drug *sarsaparilla* (*Smilax*) commanded 200 times as much in New York as the Amazonian collector received for the root. *Sarsaparilla* is just an over-the-counter herb, not a finished pharmaceutical prescription. Finished pharmaceuticals are often several magnitudes more expensive than the crude plants from which they derive.

Also, the new attitude of green consumerism resulting from the concern for environmental conservation and the consequent preference for natural products is providing a new advantage and acceptance for non-wood forest products

A challenge is to make the best out of this opportunity, through development of appropriate technology, local entrepreneurship and managerial capability to promote processing of non-wood forest products without neglecting the local community needs

In Relation to Institutional Needs

One of the major ills afflicting the non-wood forest products sector, more than any others in forestry, is the institutional neglect relating to policy, strategy and plans, legal rights and arrangements, incentives, development of skills, access to and availability of information and support from public administration

In most forest sector policies, wherever they exist, non-wood forest products get a mention in passing, but without clear objectives, targets and strategies for development. This lacuna leads to the lack of appropriate plans, programmes and projects related to non-wood forest products, and inadequacy of investment. Because of this, there is hardly any emphasis on developing and maintaining a database on these products

A comprehensive and well-articulated policy is vital for development of non-wood forest products. Such a policy, among others, would specify the relative role of non-wood forest products in supporting socio-economic development, poverty alleviation and environmental conservation, suited to the situation of the country concerned.

The policy should provide an objective and balanced view of the sector. Rather than being overly obsessed with commercial interests or subsistence needs, it should address such issues as incentives, development of technology, level and nature of resource use and management, product development and promotion and institutional arrangements. It needs to provide a new legal and ethical framework to protect and regulate the different uses of non-wood forest products. Also, strategies for translating policy objectives should allow resources to be sustainably used

Research, extension, and human resource development through education and training are important institutional services. Efficiency of these services in relation to non-wood forest products, will be reflected in how far these products support socio-economic development and how far it succeeds in the market place, without jeopardizing their role in supporting local communities

Research needs for improving technology related to non-wood forest products are tremendous, touching upon all aspects of their management and utilization

Appropriate research facilities and qualified/motivated researches are an

important requirement to address the complex array of problems. Linkages and networking arrangements need to be established with related institutions (e.g. with botanical, phytochemical and pharmaceutical research organizations) to facilitate information exchange and transfer of technology.

The magnitude of the task involved in establishing effective extension and a relevant system of education and training to address the need of non-wood forest products sector is equally enormous.

Broad-based involvement and collaboration of all concerned institutions and entities appears to be a rational and desirable approach. This will help to pool resources and knowledge in order to address the urgent issues affecting the non-wood forest products sector. Households, local communities and organizations, private sector, business establishments, financing agencies, research and academic institutions, public administrative bodies and non-governmental organizations, all can play important roles in accelerating a healthy development of non-wood forest products. It is also necessary to curtail or eliminate some of the erstwhile practices which have led to depletion of natural resources, e.g., exploitative middlemen, and debt-based relationship between traders and collectors/cultivators of non-wood forest products.

Effective participation of local groups, women and indigenous communities would call for appropriate legal provision regarding tenurial rights and security, incentives, sharing of benefits and so on.

A healthy institutional system alone can provide an atmosphere conducive for birth and growth of entrepreneurship and long-term investments and improvements.

In any complex institutional system, conflicts of interests are natural. But they are resolvable through compromises, if the development objectives are clear and well understood. For example, almost no one will argue that environmental conservation is to be achieved by halting economic progress. However, there is need for certain well-founded criteria as to how conflicts can be avoided in achieving different objectives. With regard to non-wood forest products, this is not an easy task. Each country will have to design criteria and related norms appropriate to its situation.

In this connection, proper planning is very relevant and crucial. Plans provide the basis for investment and development. And plans are only as good as the information on which it is based. Lack of adequate information makes plans on non-wood forest products weak.

Several factors have contributed to the lack of statistical information on non-wood forest products. Some of them have already been touched upon earlier. One aspect to be highlighted is the lack of an adequate universally applicable classification and statistical system for non-wood forest products, to facilitate aggregation of information at national and international levels. Due to this, statistical information on non-wood forest products are not properly or regularly

reported, and they hardly feature in national accounts. Few of the products on which information is available normally get reported under other sectors: agriculture, horticulture, etc. Thus, what we get is a distorted picture of the non-wood forest products sector.

Apart from the lack of a reporting structure, bulk of transactions of non-wood forest products takes place outside the formal and organized system. In such cases, national accounts and other statistical systems can accept estimates based on proxy measures and other valuation methods. The sheer number of people benefitted or the imputed value of unreported consumption of non-wood forest products such as fodder/forest grazing, traditional and herbal medicines, non-wood construction materials, food and edible products from wild sources, culinary herbs, flavours and fragrances and dyes and colourants are sufficient to indicate the important role of these products. Adequate efforts in that regard, however, are yet to materialize.

A challenge here is to plan and implement innovative approaches which are equal to the magnitude and complexity of the problem involved.

CONCLUSIONS

The plethora of issues affecting non-wood forest products and the challenges they present do not indicate an impossible or hopeless situation. It is to be pointed out that the issues and challenges presented here are an aggregate of situations observed, and are global in nature. They may have some similarity and relevance to country situations, but they do not represent the situation in any specific country. Actually, the issues and challenges in specific country situations are capable of being addressed effectively and positively. That represents an opportunity.

Non-wood forest products are not just a group of products. They are the basis of a concept of integrated and sustainable management of forest resources. Operationalizing the concept would call for a balanced and holistic approach to forestry, as well as fundamental institutional changes.

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Management Perspectives of Minor Forest Produce

G.P. Mauthani

INTRODUCTION

Creator is not prodigal. Nothing of His creation can be termed wanton, aimless and useless on this earth. Almost all the mythological and scientific thinking in the world have not been able to describe fully and perfectly the stupendity, immensity, vastness and countlessness of the manifestations of the Almighty. According to E.O Wilson there may be 100 million species world wide. Erwin estimates 30 million species of plants and animals in tropical forests. It is estimated that about 1.7 million species, formally identified and classified represent only 5% of the total number of species now present on the earth. Though extinction of species also has been a predictable feature of evolution since life appeared on earth some 3.6 billion years ago but man has been the major cause in this extinction. Species which are of MFP (Minor Forest Product) value only have suffered more in this regard. It is dangerous to become instrumental in the destruction and decimation of even minutest creation of the Creator by our short sighted and short term policies and actions. Forester, being most intimate and concerned about wild flora and fauna, has to play a key role through forestry in minimising and retarding such extinctions.

Forests and foresters have very complicated onus of discharging three contradictory responsibilities simultaneously. These are

- i) environmental and ecological security of the nation and its people,
- ii) socio-economic advancement of the majority of the urban and rural middle and lower segments of the society, and
- iii) commercial and industrial development of our developing nation.

For environmental and ecological security restrictions, regulations and restraints are the fundamental requirements. But the socio-economic compulsions of the socially and economically less or unprivileged people with their exploding population necessitates and culminates into unrestricted, unrestrained, and unregulated use of the forest ecosystem. Both these also need the resources to comprise variety of floral and faunal richness. Just contrary to these, commercial and industrial economies are concerned with the bulk production of a few commercially and industrially relevant commodities to be produced in bulk and specific sizes. Management perspectives with regard to forest have to

accommodate these situations in a balancing way. For tree species, there has been bias (at least) towards commercial and industrial economies. But MFPs have so far not been adequately and properly managed even for these economies. There is urgent need to develop proper management perspectives for forests in general and MFPs in particular.

WOOD ORIENTED MANAGEMENT

Historically, forest management for which silviculture had been a tool, was dominated by the market economy and thus commercial and industrial economies reigned the forestry practice most. This situation gave disproportionate importance to timber and wood production. Today it is becoming evidently clear that nature never meant timber to be the only and major product of forests, for timber production the ecological limits were transgressed. In forests, non-timber items are more important from socio-economic point of view. Out of these also forestry had so far concentrated on a limited number of commercially and industrially important species.

India has 14% of its population as forest dwellers. This population is poor and forest dependent. But ironically the management of forests does not accommodate adequately the needs and wishes of these people nor they have the deserved say in it. It continues to be subservient to the needs and comforts of those who have no direct and inevitable dependence on forests. The management strategy cares more for the few commercially and industrially important species and products. In the assignment of the role of forests in the service of the human society, the needs and greeds of the better-placed people get more importance. The silvicultural systems, methods of yield regulation, and techniques of tending the crops prescribed in the working plans of the forest departments testify these facts. Now shift towards JFM is developing but even then the old management bias is being pushed up. Major handicaps are the rigid attitudes and technologies developed in more than 125 years of the forest management.

Policy makers also attempted, without much success, to draw on forest timber to solve the fiscal, economic, social, and political conflicts. Forests have been used as escape-valve for demographic and economic pressures. Political expediency prevailed over ecological considerations. Due to this, the value of the forests and forestry has been very much underrated and neglected with regard to the non-wood products. An asset that is under-valued, is an asset that will inevitably be misused. Entangleables like oxygen yield, water yield, soil and moisture conservation, aesthetics, genetic variation, climate regulation, carbon sink, nutrient cycling, environmental sustainability, curbing green house effect, etc., have not been monetarily valued. Though comprehensive direct measurement of welfare value cannot be made, but even the most important

tangibles other than wood remain under-estimated and under-valued. Management of most of them, if at all attempted, had been just incidental to general forestry and that too without understanding and caring for the ecological interrelationship of the various constituencies comprising the forest ecosystem.

FOREST DWELLERS DEPENDENCY ON MFP

The forest dwellers and the other forest dependent people, derive their spiritual, aesthetic and economic well being from forests. For them, the MFPs are in fact the Major Forest Products. Studies in Bastar District of Madhya Pradesh had revealed that out of an annual income of Rs. 1700/- per capita Rs 1500/- was from the so called Minor Forest Produce (MFP). Studies in Gujrat showed that in forest regions 27% adults and 72% children collect MFPs. In fact, the MFPs have greater potential in supporting the livelihood of the forest dependent people and at the same time contributing substantially to the national economy. Even at present, with the commercialization of a few MFPs, 35% income from forests is contributed by these products in Madhya Pradesh. These give gainful and sustained employment right from the primary collector to the sophisticated urban elite.

VARIETY OF MFP YIELDING PLANTS

There can hardly be any plant or plant part which does not yield any produce of some or other use to mankind. But our knowledge is very limited. Much knowledge, confined to the rural-folk in general and tribal people in particular, has not been documented for the so called civilized world. Unfortunately, much of such knowledge gets lost in the oblivion. Based on the available scanty knowledge it is estimated that there are about 3000 plant species in India which yield wide variety of minor forest products. MFPs have been a part of human life probably from the day of human creation. But at present only 126 items are reported to have developed marketability. There is much food and medicine that is obtained from trees besides timber. About 70 different foods come from the ground. When we talk of MFPs very quickly and spontaneously medicinal plants and herbs automatically come in the forefront. Forests provide us with the greatest pharmaceutical drug-store that we know of. Many tribal districts of India are the ethnobotanical treasure houses. Madhya Pradesh is also reported to have about 550 angiospermic plants of medicinal use. There are 2000 species of plants reported to be of medicinal importance in the Indian system of medicines (ISM). One of the earliest treatises on Indian medicine, the **Charak Samhita** (100 B.C.), records the use of 340 drugs of vegetable origin. Out of 2000 drugs recorded in **Indian Materia Medica**, over 1800 are of vegetable origin. Similarly present contribution and future potential of oil seeds of forests origin are not meagre. According to Garg & Mishra "forests are the perennial

source of more than 10 million tonnes of minor oil seeds from about 100 tree species which are yet to be exploited for the use in oil industry" 1300 species are reported to possess aroma and flavour imparting components and bulk of these are endemic. The political and economic worth of beedi leaf is so well known. Out of the numerous MFPs, sal seed, myrabolans, resins, gums, agar, lac, tannins, sisal, sabai, orchids, canes, grasses, bamboos, silk cocoons, katha, tamarind, chirounji, mahua flower, etc., are also a few more items which have assumed greater social and commercial importance

NEW MANAGEMENT APPROACH

The approaches of urban to rural and top downwards have to be discarded as a first step towards the new system of forest management. Local people should be considered the front line managers and their needs, the first charge on the products of the forests. Conservation, which is being talked about so much can succeed only when it coincides with the self-interest of the relevant constituency. And here bulk of the self-interest of the relevant constituency centres more around the Non-timber Forest Produce. These can be managed without harming the forest ecosystem. If only MFPs are exploited properly, the chances of forest degradation are tremendously reduced. The capacity of the natural forests to supply a perpetual stream of MFPs, that can be harvested without cutting down trees, has to be understood. MFPs can be harvested without damaging the complex forest ecosystem. If MFPs are developed many times, the tribal families can be supported while keeping the forests intact. It should be possible to develop a management system to meet the demands of a certain mix of products in a desired proportion. Technical knowledge, political will and sensitivity towards the need of the local inhabitants are the primary requirements and fortunately the climate is gradually becoming favourable in developing these

TRIBAL FOREST LINK APPROACH

Amongst the forest dependent people, schedule tribes (ST), contribute the most. It is not a sheer coincidence that 'tribal rich' states are 'forest rich' also. It is tribal-forest symbiosis and cultural philosophy of tribal communities that could maintain the forest preponderance. Tribals have always been culturally and sentimentally attached to the forests. They draw their sustenance largely from the forests. Even today there are tribal villages where people are not adequately used to agriculture. Commercialised and timber-oriented forest management has seriously jeopardised the tribal habitats. Their status has been reduced to mere seasonal wage earners and thereby weakened the tribal-forest bonds of sentiments. The trio of tribal-forest-ecology urgently needs a change in the forest management approach. The change should necessarily put the so called MFPs in the forefront.

CONCEIVING MANAGEMENT MODELS — PROBLEMS AND SOLUTIONS

In order to conceive the new **silvo-ethno-economic management models**, it is necessary to locate and understand the problems, deficiencies and remedies. Attempt has been made to enumerate and describe these in the following paras:

a) First and foremost is the intimacy with the forest ecosystem, which should not exclude the people in and around the forests. The way this system reacts to the benefit or otherwise of the forests on the one side and the people on the other and the optimal levels of both qualitative and quantitative interference patterns, guaranting the sustainability of the entire system have to be understood and determined. Present understanding is grossly inadequate and biased. When the words 'people in and around' are used the intention is to include the entire resource base even outside the conventional forest boundaries which at present is not recognised as a constituency of the 'forest ecosystem'

b) As far as forest resource constituency of the 'forest ecosystem' is concerned, the following questions have to be accurately answered

- i) What we have?
- ii) Where it is? and
- iii) How much and of what type?

The answers to these questions in respect of the resource base outside the conventional forest boundaries are known to some extent but not about the resource inside the forest.

c) Probably hundreds of items can be listed as MFPs. But it will be difficult to place all at equal footing. In the fitness of the things national, regional and local level lists should be prepared. The listing may be done keeping in view the eco-ethno importance of the items. Here 'eco' relates both to ecology and economics. Presently the market economy is overriding all other considerations. This intention can be substantiated by quoting the examples of 'Sal Seed' and 'Tendu Leaves'. Both are proving good revenue earners to the state ex-chequers. But the ecological impact of the former and health-hazardousness of the latter stand totally ignored before their earning capacity. Even in respect of these, no systematic studies have been carried out.

Ecological, socio-economic, harvesting, storage, processing, value-addition and marketing studies should be given preference to the items listed in the national, regional and local lists in the reverse order of priority, i.e., local, regional and national. Of course, items common to all the lists should get the top most priority. Second in priority should be those appearing both in the local and regional lists. Local, regional and national list items would stand in the third, fourth and fifth priorities respectively. There will hardly be any items appearing only in one of the three lists but chances of this happening cannot be ruled out.

Within the above suggested listing, further sub-classification can also be according to the environmental, socio-economical, commercial and industrial importance. Here again the items can fall in one, more than one or all the four sub-classes. Environmentally important plants which are threatened, endangered or at the verge of extinction and simultaneously have great socio-economic importance should naturally attract the first attention. Computer softwares can be developed for both above mentioned listing

d) As far as forest working plans are concerned there are either no or very crude management prescriptions. Traditionally, these plans are addicted to catering the timber production requirements. Silvicultural systems were developed for commercially important tree species. Regeneration techniques were also developed for these selected elite species. Climber cutting and eradication of species interfering with the elite species are still prescribed in many working plans. Yield calculation and regulation were done only in respect of timber. Grass, fodder, fruits, seeds, leaves, roots, barks, bulbs, flowers, fibres, flosses, mushrooms, orchids, etc., are still not given the desired importance in the physical and financial forecasts. Canopy manipulations and thinning intensities are prescribed for girth and height increments and not for grass, foliage, fruit, herbs, shrubs and climber production. Very recently, working circles are being formed for a few MFP items. But these do not prescribe their conservation and development. Stock maps show the details mostly in respect of timber species. Now bamboo stockmaps are also prepared separately. But adjustment of tree canopy for bamboos and other MFP yielding plant growth has not been dared. Resource and socio-economic surveys also do not give the desired attention to MFP items.

It is high time now that the forests are managed for species mix, both horizontally and vertically. Even for single species, product-mix management patterns may be developed. Economics of forest management should take into account, such indirect gains also, which accrue in the form of food and income to the people in and around forests. The degree and type of canopy manipulations, weedings, cleanings and thinning should be determined for yielding forest food and other non-timber forest produce. Tree harvesting should take into account the full-tree utilisation including all useful non-wood products obtainable from a tree.

Presently felling of fruit yielding trees is prohibited but their management for qualitative and quantitative increased yields is not attended to. No stock assessment is done in respect of these species.

Fodder from forests has not been recognised as NWFP (Non-wood Forest Product) of importance. There are numerous fodder yielding species in the tropical forests. Even grass yield is also only incidental to the wood yielding tree biased forest management.

Keeping all other ecological points in view, optimisation of canopy densities

for different forest types need to be arrived at to optimise the fodder and grass yield also

Working Plans should mark areas rich in certain MFPs in the stock maps. Attempts should also be made for product quantification. The chapters on local demand, markets, market-prices and statistics of growth and yield should deal with MFPs as elaborately as possible. In aerial photography and satellite imageries, softwares should be developed to interpret the occurrence and types of layers below tree canopies—specially the MFP yielding plants. It is not only the stock assessment which should be covered by the Working Plans but documentation of the indigenous knowledge in the area of the plan should find place in Chapter III of Part - II under 'Utilisation of the Produce' or Chapter III of Part - I. Even in socio-economic survey report, a sub-head 'customs of the local people' can be introduced. In Chapter II 'The Forests' local sub-types should recognise sub-types on the basis of MFP yielding herbs, shrubs and climbers.

For a state and also the country as a whole, zoning according to the richness in a particular type of MFP has to be done and accordingly state level and country level maps should depict these zones. Zone may be distinctly separate or overlapping.

e) Information regarding the present yield and prices is either totally unknown or at the most partially known. Items which are exported or consumed by big industries are known to the extent of the quantities exported or consumed. Quantities otherwise consumed locally and/or internally remain mostly unrecorded. Even through these sources the real ecologically exploitable quantities cannot be reflected as there is either over or under exploitation.

Multi-point sales are involved in MFP trade. The village level collector, local level small purchaser, the big whole sale dealer, the processing and/or manufacturing trader, the exporter of the raw material or finished product, importer of finished goods and shopkeepers of internal or local finished goods are the various sale stages involved in MFP trade. The prevailing prices at these various sale points are not accurately known, let alone their reasonability. In case of beedi-leaf, the last point sale is estimated to be about 10 to 15 times more than the first point sale. In case of certain medicinal and aromatic plants, the difference may be even 100 times. Above situation causes economic and ecological degradation at one end and economic accumulation at the other.

The labourer involved at the starting point, in order to earn sufficient for his living, spends more time and energy to collect more raw material. In this process both the labourer and the resource get over-exploited. If the source of raw material is natural forest, since there is no system of regeneration, the resource depletion is some times total. Many valuable species have been wiped out from the floral map of the nation, many others are at the verge of extermination and still others are highly endangered.

Lack of proper various-stage trade information becomes a serious bottle neck

in planning for conservation, creation, development and utilisation of the MFP resource. There are hardly any perfect and all-stage economic packages for this resource. Except the local labourers involved in collection, the agencies and individuals involved in the intermediate stages are also not properly documented.

f) People in and around forests have age old knowledge and intimacy with the forests and its anatomy. Indigenous people have accumulated intricate knowledge of millions of hundreds of forest plants. But this knowledge certainly needs documentation, updating and refinement.

There are some items in respect of which regeneration, propagation, harvesting and sustainable management have been developed. Bamboos and canes are the foremost amongst them. Some have come to stay outside forests as cultivated crops. But majority of the items are facing the wrath of commercialization in the form of total decimation. Lopping and felling of *Tendu*, *Sal*, *Aonla* and *Chironji* trees is a well known example in Madhya Pradesh. Many bulbs and root yielding plants have already disappeared. Plants which yield flowers of MFP value are also likely to face extinction, as the source of regeneration the seed, does not get the chance to be formed. Where bark is the MFP product, debarking kills the plant outright. These are few examples to cite in this context.

Quality of methods of exploitation, their impact on the naturally growing stocks and consequently on the ultimate ecological and economic environments have not attracted desired attention of the State and the Central Governments. Even for the products with best marketability, the man at the rock bottom is very ignorant and uninformed about their profitability. He, thus does not get reasonable price and faces the economic sustenance problem. Such situation compels him to resort to over-exploitation of the resource and consequently over-exploit himself and decimate his source of earning. Systems of regeneration, cultivation and harvesting will have to be developed.

Most of MFP items need semi-processing and storage before sale by the primary seller. In absence of the knowledge of these skills, the sales by the primary collectors are generally distress-sales as they are forced to sell immediately after collection for the fear of deterioration in quality. Many products can fetch better prices after semi-processing, value-addition and offering at the proper market environment. If this could be done the eco-over exploitation of both the resource and primary collector will be controlled considerably.

Forest based industries, as far as possible should be established near forests. In respect of many MFP industries, this is possible. Such industries will generally be of cottage-industry level. This action will bring the primary and secondary markets at the door of primary collector. It is possible to create such facility in the form of cottage industries. 'Task Force on the Development of Tribal Areas' had rightly recommended establishing forest based industries in tribal

areas There should be organisations at NGO levels to ensure proper deal to the primary collectors in prices and wages. Performance of the existing government organisations should be evaluated through NGOs. The primary collector should be given the role of collector-cum-processor-cum-manufacturer

g) There are many items which face severe market fluctuations. Invention of synthetic products, unpredictable and fluctuating production cycles, politically motivated policy-fluctuations, etc , are many problems which are faced by the MFP trade. This situation does not allow the MFP trade in many items to flourish. It is mostly the rural population, of that also the tribal and backward classes, which lean heavily on such MFP oriented economy Production and market uncertainties hit them most. These uncertainties disenchant the people from such products.

Creating assured and profitable market and forecasting the production patterns can boost up trade in such items. Lac is one of such items which is well known for market fluctuations. Sal seed is the example of the product which is famous for the severe production variations. Kacharia (bark of Harra fruit) suddenly went off the market due to invention of synthetic tanning material Sal seed oil also faced more or less similar situation Most of the MFP items are also of annual nature and face the wrath of climatic variations. Droughts, storms, fires, insects and pathogens, etc , are the environmental hazards which annual MFP crops face.

h) Mention has already been made earlier of the 'silviculture' and its status in respect of MFPs According to Toumey and Karsiteu, it is defined as the establishment, development, care and reproduction of stands of timber Others define it as a science of woods and wood lands And still others try to generalize it as the art and science of forest crops With all these academic definitions, the fact remains that in the by gone days, silviculture was almost synonymous to wood production And even in that it was the timber production Fire-wood was incidental to timber production and with industrialization, pulp and other types of industrial wood production claimed place in that art and science. It is but obvious that this science developed for adding to the richness of the already rich urban and semi-urban societies. All attention was paid to the commercial and industrial wood producing species and that too at the cost of other species occupying both the horizontal and vertical spaces Even the people, who have direct life linkage with these so called unimportant species, faced utter neglect and alienation It took about two centuries to realise that the direction given is undermining the very base of not only of the forest people but of the entire humanity

The silviculture, no doubt, neglected the non-timber product values of forests and today forestry finds itself utterly ignorant about the knowledge of growth and development of these values. This ignorance is resulting into the fast decline of plant species yielding various NWFP.

Even the concept of plantation forestry is dominated by the monoculture of commercially and industrially important tree species. Only a very few NWFP species could establish themselves as cultivated crops outside the forests.

The complex dynamics of species interrelationship in forest conditions will have to be understood. The amount of overhead and side light to be admitted for different species combination and frequencies and plant densities for desired quantities of different product yields will have to be investigated. The eco-interaction and impact of such combinations would need to be understood. Now there is no doubt that natural forests will have to be managed with respect to the natural-mix of the indigenous species on a given site. Forest productivity will also have to take into account the product-mix. It is very necessary to understand that under a given set of forest composition, productivity must accommodate all the environmental values like water yield, soil and moisture conservation, qualitative and quantitative sustenance of the forest dependent people, global warming, ozone layer depletion and climate regulation. So a modified silvics for the natural forest ecosystem has to be developed.

In plantation forestry also there is possibility of under and intercropping of the lower level canopies along with tree canopies. Grasses, herbs, shrubs and even some climber species can be co-crops. For such inter/under cropping tree spacing can be increased. Of course under such conditions species wise yield will be effected but the net economics of production is bound to be better than a single species cultivation. Under such mixed cropping, the harvesting intensities, timings and patterns will be different from the existing monoculture plantations. At any stage of harvesting, adequate mother plants will be necessary for regeneration and revegetation of the site.

Commercial scale plantations of MFP yielding species may be taken up on sites specially suited and assigned for commercial production both inside and outside forests, either as mono or mixed cultures. Nursery and plantation techniques along with the full economic packages, from planting to harvesting will have to be developed for such plantations. For herb and shrub species, the Tissue-culture technology is likely to be very promising. Vegetative propagation through mist-chamber plants may also prove economical.

Cultivation of certain MFP plants, specially the medicinal and aromatic plants outside the forests has great prospects. Under agroforestry scheme, this type of cultivation is bound to prove most economical. The problems of shade, competition for moisture and nutrients, gestation period, crop geometry, etc., are not likely to be as acute as in case of tree-crop combinations. Large scale pure cultivation programmes can also be taken up by Forest Corporations and medium and small cultivators.

But as at present clear practicability about identification of the species, their commercial cultivation packages, assured forward trade linkages, cost benefit analysis, internal rate of returns are not known. Though theoretical knowledge

of these aspects is available in abundance. Recommendations after recommendations are being piled up by holding seminars after seminars. But what is needed is a very practical approach and clear-cut prescriptions of practical applicability. A list of such items along with field and trade manuals should be the solid outcomes of seminar or workshop on MFPs (which include medicinal and aromatic plants as well).

EX-SITU CONSERVATION

Conservation of genetic resources of MFPs will be crucial for future development. Silvicultural system developed for a species and product mix will take care of the *in-situ* conservation. For *ex-situ* conservation gene-pool gardens are already in vogue. But here again the herb, shrub and climber species are not getting adequate attention. Regional, national and international collaboration will be needed for *ex-situ* conservation. Creation of MFP and medicinal plant gardens was attempted in Madhya Pradesh but it has not met the desired success for various reasons. If these are linked with commercial cultivation of readily marketable species in private and corporate sectors, the chances of success are likely to be more.

RESEARCH AND DEVELOPMENT NECESSITY

a) MFP to Appear on R & D Agenda

There can be no progress without Research and Development. Forestry sector in general is very much lacking in this regard. The priorities fixed for forestry research concentrate more on trees, wood and related topics. Even these topics cover more the basics and theories. The practical field oriented applied research has yet to find its proper place in the research agendas. As far as MFPs are concerned, even the basic and theoretical types of researches rarely appear on the agendas.

b) Short and Long Term Perspective

The constraints described in earlier paras form the basis of research priority. Short term research programmes can be drawn in respect of problems needing immediate solutions. Solutions which are likely to take long time and can be deferred for some time may be tackled through long term research projects. In the former, mostly the applied type of research will be preferred. But technology development and actual application of research and technology should also form part of the research and development programmes. Research and study needs are proposed on these principles under category A and B.

A. Applied Research and Technology Development

i) *Appropriate Organisation at Local, Regional, State and National Level:* The traditional pattern of Forest Department dealing with MFPs as a secondary subject has not proved its worth as far as MFPs are concerned. Besides Forest Department many other departments claim the subject to fall in their purview. Rural Development, Agriculture, Tribal Welfare, Khadi and Village Industries, Industries, Sericulture, Social Welfare, Vocational Training, Indian Systems of Medicines, Trifed, Markfed, Co-operative, STC, etc, are the numerous departments of Government which associate themselves with the MFPs.

It is a high time that some suitable organisation which can combine the functions of other related departments and serve as a single window be formed. It may be in the government sector or public sector. The organisation should be from grass-root to the higher policy making levels. Such organisation will have to be conceived after a lot of thinking, discussions and study. Many suggestions are already on record. Probably three-tier organisations will suit the requirement. Two of these may be one each in the Forest Department and Rural Development Department at the State level and one apex organisation named as National Council for Minor Forest Produce (NCMFP) at the Central Govt level. This organisation should also act as co-ordinating and monitoring agency. The structures, functions, jurisdictions and linkages of these three organisations within themselves, radiating out of them and converging into them will need intensive studies.

It will not be unfair to comment that various institutional arrangements made so far suffer from in-efficiencies, deficiencies and self centeredness. They did many things except for the welfare and development of MFPs and lower level people dependent thereon.

ii) *Listing of MFPs:* Simultaneous to the formation of the organisations mentioned under i) above and immediately after these organisations come into existence, drawing out local, regional and national lists as suggested earlier will have to be taken up.

iii) *Need for MFP Atlas:* After ii) above is done, detailed MFP atlases of the country for national, regional and local levels will have to be prepared. What these atlases will depict and how the administrative, ecological and anthropological features will be synchronized and depicted, will be the items of research.

iv) *Stock Quantification.* Quantification of the products in the order of quality is one of the greatest handicaps in developing MFP trade. Proper system of inventoring and stock quantification have not yet been standardized even for

many commercially important MFPs. Then such quantification should be done at certain time intervals. Stratification into occurrence and intensity zones and thereafter developing sampling techniques, sample sizes and enumeration/assessment techniques will have to be developed. For species which have certain variable cycles of production and production quantum will need to be dealt with separately

v) *Collection Methods:* Very destitute, infirm and poor people are the most concerned with collection of MFPs. Some of the items are eaten and also sold for income generation. The methods of collection are very crude and at times even destructive resulting sometimes in extinction in the wild. Methods of collection which are harmless and maintain specific use values, collection times and intensities should be such that sustained yield and perpetual production are not jeopardized

vi) *Storage Techniques:* After collection, there is generally a time-lag between collection and disposal. This time-lag may be short or long and thereby necessitate storage. The storage techniques are not adequately known, due to which the produce gets spoiled and deteriorated, thereby losing the use and sale values.

vii) *Semi/Full Processing and Grading* Some MFPs can be stored after some sort of semi-processing or even full easy-processing. This operation will reduce the bulk of the volume thereby needing less space for transport and storage and also increase the sale value. Proper grading before sale will further improve the chances of getting better prices. Such semi and full-processing techniques save both the resource and its primary user from ecological and labour exploitation. There should be elaborate quality control and grading values for different stages of the raw material offered for sale.

viii) *Value-Addition* In addition to processing, even value-addition is possible and necessary in many MFPs. The value-addition techniques boost up the economy of the primary collectors considerably. Better collection methods, processing and value-addition are specially useful in perishable MFPs and medicinal plants.

ix) *Standardisation of the Units of Measurement:* Presently the MFPs are purchased by the local traders by number, volume or weight. The practice is changed according to their convenience. This results into under payment to the villager. There is need to standardise the units of measurements

x) *Documentation of Indigenous Knowledge.* There are hundreds of items which can be marketed but for want of their utilitarian values, they remain unexplored

Some of them are known to local rural societies. There are still others which are known for very useful values of medicine, food, aroma, etc., by the local people.

Plants with anti-pregnancy qualities and those useful as wound healers, bone-jointers, etc., are quite commonly known in the villages. So the knowledge of ethno-pharmacology in rural India should be dug out and documented.

Like this, the store-house of such knowledge about MFP items amongst the tribals, village Ojhas, *boodhas* (respected old people) need exploring and documenting for the benefit of humanity. Indigenous people often possess more knowledge about species characteristics and ecology than the researchers. The knowledge acquired by them is the result of thousands of years of experience inherited from generation to generation.

xi) Information of Prices: The economic value and the real market worth are not known to the villagers. A system should be developed to apprise them of the real worth of their produce from time to time. Information flow-channels need to be invented.

xii) Organisation at Grass Root Level: For uncultivated natural collections from the forests, the quantities involved at individual or family levels are very small. Marketing of these small quantities results into distress sales. Even for bigger collections, lack of marketing skills and compulsions of immediate basic sustenance exposes the primary collector to the shrewdness and exploitative character of the intermediaries. Even the properly stored, processed and value-added items have to be sold by the villagers at throw-away prices. Operations in MFP trade are so disorganised that the profit always goes to the intermediaries. Only suitable and solid grass-root organisations can solve these problems.

xiii) Steps Needed for Sustained Yield. Present methods of exploitation generally result into the total depletion and extinction of the resource base. Many plants can be kept in sustained yield state by developing easy silvicultural techniques while others can be easily cultivated. Many can be cultivated out on hedges, bunds, backyards and marginal agricultural land. Cultivation can be in crop combinations or even pure cropping.

xiv) Government or Corporate Sector Support: Even after creation of grass-root organisations as mentioned under sub heading xii) above, marketing system and techniques will have to be taught to these rural organisations. Some sort of government or corporate support will be needed in the beginning. But the type and degree of support and infrastructural requirements are the subjects of investigation. Attempts made so far have not withstood the tests of success and credibility.

Above are some of the aspects under category A, needing immediate and

short term investigations. For long term investigations also the list is no shorter as MFP research has faced severe and continuous neglect so far. Following are a few aspects which could be conceived.

B Applied as well as Basic Research

i) *Silvicultural Systems.* Forests are the original and natural store house of all the MFP yielding species. But as stated earlier, the silviculture and management systems developed over more than 15 decades of forestry history in India, timber yielding species have dominated the total panorama. Canopy manipulation, adjustment of growing space, root competition, moisture and nutrient availability, regeneration, tending, thinning and other cultural operations, artificial regeneration, forest utilisation, forest physiology, forest genetics, forest based industries—every thing was directed towards wood production. Even such an important item like bamboo remains a secondary species till today.

Developing silviculture and management models for multispecies, multistoried and multiproduct mix in different proportions of desired yields and under different eco-climatic conditions will need intensive, persistent and long term research efforts. The optimum density at different canopy levels will have to be determined for different objectives. Under such conditions, determination of the long term ecological impact on the forest ecosystem of such models will have to be done.

ii) *Introduce MFP Bias in Eco-Restoration.* These days major programmes of afforestation comprise of rehabilitation of degraded forests. In these, the emphasis is on taking advantage of the existing root stock, improving the existing malformed crop, adopting and tending existing regeneration and advance growth and supplementing by planting indigenous tree species. Again the bias is mostly on tree side though the trees do comprise the locally useful ones. Grasses, herbs and shrubs are considered incidental to protection. Climbers do not fall even in that category. For tree growth these floristic components are still sacrificed. Main problem is the ignorance about the ecological and socio-economic values of the herbs, shrubs and climbers. There is a huge gap in the knowledge of the silviculture of many miscellaneous species. And about herbs and shrubs, we are very ignorant. There is need to study the role of these in ecological and economic restoration of the degraded sites.

iii) *Under/Inter Cropping of MFP Species.* Under corporate and private sectors, plantations of commercially important tree species are still in vogue. Fast growing short rotation species like *Eucalyptus* species, *Populus* species, Bamboos, *Gmelina arborea*, *Casuarina equisetifolia*, Tropical pines, *Anthocephalus chinensis*, *Albizia falcata*, *Leucaena leucocephala*, *Michelia champaca*,

Acrocarpus fraxinifolius, *Duabanga grandiflora*, *Ceiba pentandra*, *Grevillea robusta*, *Tetrameles nudiflora*, *Trewia nudiflora*, *Broussonetia papyrifera*, etc., are some of the fast growing species under given site and input conditions. But out of these hardly 3–4 are commonly cultivated. Techniques of high density, intercropping and undercropping are being adopted. But no standard combinations for species and product mix have been evolved so far. Trials and errors are going on.

There is tremendous scope of growing tree crops along with the inter or under crop combinations of MFP species, Medicinal plants, Agave, *Eulaliopsis binata*, etc., can be very profitably combined with multiple use tree species. But economic models of such combinations need to be developed after scientific research.

iv) *Need for Packages for Pure Cropping*: Some annual, biennial and perennial species can be grown as pure crops also. Marginal land and small holdings can be put more economically under medicinal plant crops. But total packages of cultivation are not available.

v) *MFP Oriented Agroforestry*: Under agroforestry conditions, medicinal plants can be most useful and suitable. The problems of shade, allelopathy, root competition, etc., are considerably or even totally solved in MFP oriented agroforestry. Even tree crop combination can be more economical if multiple use tree species are planted. But knowledge in respect of this type of agroforestry is very scanty.

vi) *Quality Seed, Planting Stock Banks and Plant Introduction*: The culture of using quality planting stock is some how not developing adequately in forestry. As far as long rotation tree species are concerned there are many genuine reasons for slow speed in this. But for short rotation crops especially the medicinal herbs and shrub flora, there should be no difficulty in this regard.

Seed improvement, multiplication of the improved seed, propagation of genotypically and phenotypically superior stock, improvement in respect of the desired product, etc., can be done with better ease in medicinal plants. Unless better planting stock is provided, it will not be possible to popularise cultivation on commercial scale.

There is need for carrying out provenance trials, introduction of ecologically safe and economically useful exotics and development and multiplication of strains qualitatively and quantitatively rich in ingredients.

vii) *Plant Biology and Environment Interrelationship*: Understanding the biology of the MFP plants having short, medium and long gestation periods also

remains very neglected. Their social, commercial and industrial values have not been explored adequately for the well-being of the human society. Propagation techniques, nursery and planting techniques, seed and plant improvement, economic harvesting, increased production, etc., cannot be properly understood and undertaken without understanding the plant biology and its interrelationship with overall environment of the locality. Biochemical and physiological studies will have to be undertaken as well.

viii) Information Network on MFP Trade: Small scale sporadic plantations mostly raised on experimental level and as germ plasm banks are not enough. For economic benefits, large scale plantation units can be economically more attractive. But these attract huge investments. Unfortunately most of the MFP plants have very limited and that too very uncertain demands. Unless assured forward trading is there, making such huge investment will not attract the entrepreneurs.

Lot of market survey, demand projections and even demand creation will have to be taken up by the R & D Organisations. Direct linkage between the producers and the manufacturers will have to be established. Both the forward and backward linkages will need to be developed and strengthened. Information network on various aspects of MFP trade appears to be one of the topmost requirements. Preparation of production and trade directory is also one of the most urgent requirements.

ix) Captive Plantation Packages: The aspects highlighted under sub-heading *viii)* will automatically pave way for captive plantations on commercial scale of selected MFP plants. Forest Corporations of the country can raise captive plantations. These plantations can be linked with the small scale plantations raised by the local people. These big centres of captive plantations may take up further work of product development and improvement. But initial packages have to be given by the R & D Organisations.

x) Product Development. When we talk of product improvement and development, use of fertilizers and growth hormones, VAM fungi, rhizobium and their effects on the desired MFP constituent (including medicinal plants) naturally come in the forefront. Intricate researches like hybridization, genetic engineering, selective breeding, tissue culture, mist propagation, investigating on more uses of a plant and its plant parts by chemical investigation, storage techniques and facilities for items which lose the MFP-value with prolonged storage, will have to be taken up.

xi) Some Non-environment Friendly Systems There should be no hesitation in admitting that many MFPs which have established themselves very firmly or

rather in all pervading manner are not serving the society in an environment friendly way. The fall out of the trades of some are proving to be health hazards. It is the weaker section of the society which suffers most from these hazards. Unfortunately, the short term economic gains from some of them appear to far out weigh the long term environmental evils.

It is the onerous duty of the state and researchers to find alternative substitutes and exercise proper regulation in the exploitation, manufacture and trade of well-established MFP items. Cleaning the forest floor for Sal seed, collection of Tendu leaves for beedi manufacturer, use of Mahua flowers for manufacturing country liquor, etc., are a few examples to illustrate.

xii) Rural Economic Prosperity Perspective As emphasised in this paper, most of the MFP items have capacity to bring in eco-friendly economic revolution in the rural country side. Let us come out of our obstinate notions of considering the people in and around forests as only primary collectors and locate MFP based cottage industries there. Many silvicultural and management practices in forestry will need remodelling to help this concept. Managing *Shorea robusta* and *Terminalia tomentosa* forests for silk cocoon production, encouraging regeneration of *Wrightia* spp. *Gardenia* spp. for toy manufacturing, managing *Butea monosperma*, *Ziziphus* spp. and *Schleichera oleosa* for lac cultivation, considering development and expansion of *Woodfordia fruticosa* for dye, management of *Terminalia arjuna* and *Zyziphus xylocarpa* for tanning material, *Acacia nilotica* for gum and bark, bamboo as food material, etc., are the numerous items which need to be managed in the perspective of rural economic prosperity. Long term, though not unduly long, research will be needed for accommodating this concept in the traditional silviculture. *Bauhinia vahlu* which was considered as silvicultural nuisance, now needs to be introduced as a cultivated crop for yielding leaves, bark and seed.

The suggestions above are neither exhaustive nor complete. Many more which may be of even greater importance are escaping imagination at present.

xiii) Policies and Laws Historically, forest policies the world over, had provided incentives for the wasteful use of natural forest resources. There are numerous instances of policy induced destruction. Neglect of MFPs is one such adverse policy. It is the government policy for commercialisation of forests that undermined the sources of sustenance of tribals, created unemployment and underemployment and drove them to destroy forests for their survival. Policies and laws directly or indirectly influencing the MFPs also had rather very negative impact. Presently the policy is of harvesting without adequate measures to conserve and develop. This attitude has resulted in economic extinction in wild. Complicated policies to protect MFPs are not needed. One simple policy to follow is the communal or collective ownership or forest property rights. It is

more consistent with conservation of all forest values than the government ownership. Lasting development is not possible without conservation. But extreme decisions like banning fellings may even go against the conservation itself. In fact certain degree of induced disturbance is necessary for favouring regeneration and diversity. More bio-diversity have been noticed in areas with limited disturbance. Conservation rarely succeeds on its merits alone. Any policy in respect of MFPs has to care for the complex forest ecosystem on one hand and the under privileged and under developed forest dwellers on the other. These people lack necessary influence in political decision-makings. National Forest Policy 1988 lays down "meeting the requirement of minor forest produce of the rural and tribal population" as one of the basic objectives of the management of State Forests in the country. Under essentials of the forest management, the policy says, "Minor Forest Produce provides sustenance to tribal population and to other communities residing in and around forests. Such produce should be protected, improved and their production enhanced with due regard to generation of employment and income."

This policy also prescribes the domestic requirement of tribals and other poor living within and near forests to be first charge on MFPs. Special attention to "protection, regeneration and optimum collection along with institutional arrangements for marketing" has also been desired, to be paid. But the policy should recognise participation of the people in policy making.

Though no specific mention has been made of research made on MFPs but increasing productivity per unit of area and time of forest produce by the application of modern scientific and technological methods has been put as a priority item in the agenda of forestry research.

Above policy guide lines cannot be said as very encouraging. In fact, MFPs have the potential to become an alternative to timber for supporting the forest dependant people's livelihood as well as providing their governments with much needed financial resource. Emphasis should have been laid on the quantitative and qualitative assessment of MFP resource. There is a great scope of making a forest based economy shift in the rural India through MFPs. The emphasis in forest management should not only show a kind gesture by making mention of MFPs but there should be a major shift from timber production to MFPs production. Present pricing and marketing policies will need to be reviewed.

Presently, the status given to MFPs is really minor; suggestions are put forward from time to time to change the nomenclature. But by simply changing the nomenclature, the status is not likely to be elevated. A policy decision is needed if mangement of MFPs could be taken out of the existing forest departments routine executive and adiministrative functions and put under different administrative and organisational set up. Creation of separate full-fledged department at State level can also be thought of.

Now forestry is taking a new shape by adopting the policy of **Participatory Forest Management**. Through this policy MFPs are bound to receive more importance and better treatment as the people will be able to influence policy making. Simultaneously, relationship of respect between the policy makers and the technical functionaries should be established.

xiv) Education and Training: Need for education and training pertaining to various aspects of MFPs, both to the officials and non-officials had also not been given proper attention. MFPs, as parts of forest ecosystem and agents of socio-economic revolution are to be intensively understood and taught. Training in harvesting methods, regeneration, processing, value-addition and storage needs to be organised and imparted on regular basis. Special attention has to be given to training of gatherers, as MFP collection is exclusively dependent on gatherers, their skill and modality of gathering.

Social justice, environmental sustainability and economic efficiency should be the ultimate goals in the management perspective of not only of Minor Forest Produce but also of the entire forest ecosystem. Since there are threats of serious or irreversible damage, the subject should not be postponed for the political and administrative reasons and convenience.

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Criteria Considerations for MFP Policy Formulation

Rauno Laitalainen

INTRODUCTION

The extremely complex entity of factors which affect the promotion of minor forest products (MFPs) has been merged in this paper into two main dimensions in order to facilitate systematic policy formulation. The two ends of the dipole are demand and supply. Both of them are surrounded by a sphere of related factors. Demand can be created by forest dwellers for their own consumption and survival or by downstream markets which follow the rules of business and monetary economy. Supply is based on the resource base which is initially in virgin forests but may be enhanced by cultivation and even by genetic engineering.

The importance of MFPs to man, however, does not depend on availability of the products or their price only. The ultimate factors which determine the role of MFPs are the values of the associated people not monetary values only but the entire value system of the people. Therefore a successful policy formulation requires a holistic approach and multi-disciplinary expertise which brings together sociologists, psychologists, economists and engineers to open horizons which foresters and botanists have not necessarily had in the past. When it is understood and accepted that the values of people ultimately determine the policy, its formulation becomes relatively easy. It simply requires the identification and interpretation of the subject-related values and their expression in a written form for debating and final decision making. Because the values determine the criteria policy objectives and statements may become preservation or exploitation oriented or anything in between.

GENERAL OBSERVATIONS

None of the countries in the Asia-Pacific region has a specific policy on minor forest products (MFPs). However, India is one of the few countries which mentions MFP in her forest policy by saying that one of the objectives is "meeting the requirements of fuel-wood, fodder, minor forest products and small timber of the rural and tribal population". This goal implies introduction of supportive

strategies through programmes which focus on social forestry and afforestation. This policy objective is very clearly socially oriented but excludes other important aspects such as; conservation of the resource base and economic contributions through downstream processing and R&D.

THE STEPS IN THE POLICY FORMULATION PROCESS

Although the policy formulation is as important as the policy itself, very few countries in Asia, have established their policies through a systematic process. India, can do so now when the National Forestry Action Plan is under preparation and the relatively fresh National Forest Policy of 1988 is being examined. The hierarchy in the process is that what is most commonly misunderstood. So it is in India also. The legislation still overrules the policy although it must be other way around. The policy expresses the national will, and aspirations, and the legislation should facilitate the implementation of the national will. One reason why policy and laws often are in conflict is that the legislation represents the past and when the new policy is introduced, it takes long time before the legislative mechanism can transform the political will into legal text and process it through the legislation and institutional systems for implementation in the field. Therefore, special attention is required to accelerate the drafting of relevant Bills as a step in the policy formulation process. The hierarchy sequence is

- a) the national forest-related values determine the policy objectives which should be made measurable for subsequent monitoring where possible,
- b) the policy statements express priorities and indicate what kind of means may be allocated for policy implementation,
- c) the strategies advise how to materialize the political will which is expressed in the policy objectives and statements, and finally,
- d) the programmes describe and quantify the action, resource allocations and responsible implementors and their roles. A legal reform is one of the priority programmes to open institutional avenues for the systematic implementation of other programmes. The function of the laws is to systematize actions of the relevant institutions and make them accountable in implementation of the policy—not to direct the policy as is frequently misunderstood.

EXAMINATION OF DEMAND/SUPPLY DIMENSIONS

Social Dimensions

Because the National Forestry Policy of 1988 puts much emphasis on the social contributions of forestry, this dimension is examined first. Although social

contributions are not the only ones which MFPs can provide, they are clearly the most significant ones in the Indian context. The poorest of the rural poor have traditionally depended upon the common forest resources. Lacking legal rights to the forest resource and capital, they have more explored it than managed Contractors, although to some extent in a better position, have similarly neglected the forest management in order to maximize profit. Consequently, forests have been gradually depleted and have given way to agriculture and pasture. The social contribution of MFPs is highlighted by the fact that the very survival of the poorest segments of forest dwellers directly depends on MFPs. They collect various plants which give food and medicines along with materials for implements and shelter thus satisfying their basic needs in subsistence economy.

Where supply is sufficient and markets show clear demand, commodities can be collected for cash to enable access to monetary economy. The extreme of the social dimension of the MFPs can be described in some cases as a question of life or death—the most fundamental one of the human values. Therefore, the importance of the MFP policy should be even more clearly spelled out than it has been done in the Indian National Forestry Policy of 1988.

Economic/Demand Associated Dimensions

The subsistence economy begins its transformation into a monetary economy when the excess of the collected MFPs are brought to a market place and sold for cash. The economic importance of the produce depends on many factors. Scarce commodities, which are difficult to be replaced by substitutes fetch the highest prices. The economic and social dimensions are very much intertwined in the case of MFPs. The share which goes to the primary collectors is hardly maximised because middlemen, money lenders, store keepers, transporters, processors and traders extract their costs and profits first, leaving a minimum amount to collectors. In capitalistic societies the markets finally assess and determine the actual retail prices but the distribution of income is left unregulated, (except the government taxes). The bargaining power and the business skills of the business partners determine who gets what and how much. The collectors are generally powerless in this game because they may be indebted to money lenders, do not know the real value of the commodities or are just simply cheated.

The economic value of MFPs can be increased significantly through industrial processing which, in turn, can be influenced by policy interventions. The import of substitutes and the export of domestic raw-materials can be discouraged while the export of value-added products can be exempted from duties. Such a policy combination can have a positive impact on employment and on social contributions. Multiple effects of such a policy are reflected even

in activated R&D. More direct are the impacts on the foreign currency balance. Various MFPs processed domestically reduce the import needs and their export brings in hard currency helping the national economy. If the primary processing is supported where the commodities are collected or cultivated, the income and employment support the local economy. The secondary processing may be directed near to exporting zones or end-users thus contributing to the urban economy.

After survival, a continued desire for an improved livelihood is one of the basic human values which can be satisfied through the sustained management and utilization of MFPs.

Supply Associated Dimensions

Resource conservation becomes an issue if the demand and supply of a certain commodity exceeds the sustained carrying capacity of its habitat. It may happen both in subsistence and market economies. Local consumption by an overpopulated community for their basic needs can destroy the resource base the same way as the greediness of merchants. The risks can be mitigated through policy interventions which encourage sustained resource management – not merely exploitation. Normally the problem in the Asia-Pacific countries is that the forest land belongs to the State which tries to control the resource, but lacks adequate financial or manpower resources to manage it. At the same time the local people are denied legal access to the forest thus eliminating their potential interests to look after the resource on long-term basis. Consequently, neither the government nor the villages manage the resource and it may ultimately be depleted. Policies which empower local people to have legal access to the resource in association with management responsibilities are more likely to maintain the resource base because villagers are supposed to look after their own benefits.

Restrictive policies which try to limit access to the resource are generally less effective. However in some situations they may be applicable as well. The preservation of endangered species, their *ex situ* conservation and establishment of protected areas for conservation of bio-diversity are some of the measures which are generally applied. Without effective monitoring and the enforcement of regulations, the risk is high that the most lucrative commodities become extinct. Therefore the responsibility of quota monitoring should be given to more than one agency – not only to the Forest Department. In many cases, neutral scientific institutions have competent researchers, villagers who patrol in the forests can follow up on what is happening in the forest on a daily basis and environmental NGOs may provide keen and competent co-monitoring.

An increasing demand can be satisfied in some cases by intensifying scientific measures, such as micro-propagation, tissue culture and genetic

engineering. The enhanced cultivation and propagation capacity reduce the pressure on the original resource base and thus facilitates its conservation. Selected plants can be cultivated as cash crops and animals can be domesticated thus reducing the pressure on the wild. Therefore, the policy measures which support small farmers and co-operatives which produce MFPs and their R&D are also forest conservation measures. In addition, positive socio-economic impacts and far reaching inter-sectoral linkages can be strengthened, reaching industries which may look distant to the forestry sector but are very important to the society as a whole, such as the production of medicines and various essential oils among others. The necessity of living in harmony with nature has been just recently rediscovered by man. Sustained management and utilization of forest resources is practiced only exceptionally, however. Therefore, transferring the conservation oriented values through policy statements into action remains a challenge of our era.

POLICY FORMULATION PROCESS FOR MFPS

The Multitude of End-uses must be Realized

The roles of MFPs vary extensively. In some situations they are necessary for survival and the fulfillment of basic human needs, in other cases their role is supplementary in the form of cash income. They may provide herbs for rudimentary nursing as well as raw-materials for most sophisticated medicines. A tribal girl may surround herself with the same fragrance which she has picked up herself in the forests as would a high society Madame in Paris who sweetens herself with the most expensive perfume made from the plant picked up by the selfsame poor girl in the forest. Extensive cottage or modern industry may have been established to process some MFPs. Examples are too many to mention ranging from honey, furniture and silk to katha, tannins and papers.

Policy Preparation and Decision Making Process are Value Based

The initial preparation is technical. When approaching the policy formulation issue on MFPs, the first question to be answered is that of who are the affected people because their values are important determinants and need to be identified. The list is quite long. It starts from forest dwellers who collect various MFPs, and includes transporters, traders, merchants, farmers who cultivate certain plants, bankers, cottage and modern industrialists and their labourers, scientists, government foresters, environmental and social NGOs and ends up with the society at large. The challenge of the policy researcher is how to get accurate enough information. Comprehensive questionnaires to all affected people become too expensive and time consuming. Their scientific reliability in acquiring value based information is also questionable. Therefore, indirect

methods may prove to be most applicable. Studying relevant research reports and mass media often leads to reasonably good interpretations to start with. They can be further checked and improved through direct communication with selected representatives of the groups of the affected people. The process, however, is as important as the product. All the relevant groups must be consulted in various stages of the process. Otherwise they may turn against the proposed policies. However, good, they may be just because these persons were not included in consultations. In big countries, like India, it is impossible to incorporate all the stakeholders. Therefore, a persistent criticism and certain opposition should always be expected regardless of the kind of policy being proposed.

The final decisions are political.

Democratic decision systems ensure that on higher national levels the elected representatives finally decide what the national policies are. So, the policy making process can be seen in two stages. First at the technical or multi-disciplinary level where sociologists, economists, foresters, environmentalists and other scientists collaborate in finding out the values of relevant groups of affected people and in their accurate interpretation. The policy proposal formulated by them will finally go through the political decision making process which follows the national mechanisms stipulated in legislation. In most democracies the Cabinet decides policy issues. The policy issues which have long term national impacts may be brought to the parliament as well. The benefit of the final decision making on levels higher than any of the sectors ensure that inter-sectoral linkages can be established. By definition, the MFPs belong to the forestry sector although they have very close links with the agricultural, social and industrial sectors as well. Policies which are considered and endorsed on the national political decision making levels can more effectively become extra-sectorally binding. Their sectoral biases can be mitigated and possible imbalances between beneficiaries corrected. Therefore, those who have drafted policy proposals should be prepared to defend their work in front of national decision makers, but also accept and respect the final decisions even if they essentially deviate from the originally proposed policy statements.

The roles of various policy drafters

Those who represent the affected interest groups are expected to highlight their viewpoints and present their cause convincingly enough to be accepted by others. Therefore, during the technical preparation process it may happen that some groups which are skillful communicators can over-influence others which may end up with twisted policy proposals. If the leadership is in the hands of neutral yet experienced experts, the likelihood of the final results becoming well balanced is higher. Sometimes even foreign experts are used to technically guide the process to ensure fair treatment of all stakeholders. Finally, depending on the nature of the actual issues and on the value structure of the final decision

makers, the policy objectives and statements may be found socially, environmentally or economically oriented.

AN EXAMPLE OF MFP POLICY OBJECTIVES AND STATEMENTS

The intention is not to advise Indian authorities in policy making but just to give some examples which are aimed at facilitating the understanding of what has been written above. Because MFPs grow in the forest, a MFP policy is expected to be included into a forest policy. Therefore, it is also assumed that this hypothetical policy would form a part of a forest policy

(a) Objectives

Minor Forest Policy objectives may be aimed for:

- i) halting the destruction of the remaining habitats of endangered species and conserving their biodiversity for the coming generations,
- ii) promoting social justice and equitable rural development,,
- iii) contributing in a sustained manner to fulfill both local and national needs of minor forest products, and
- iv) strengthening rural and national economics and reducing import needs

(b) Policy Statements

Policy statements may include the following.

(A) Policy on MFP Conservation

- i) collection of MFP species shall not exceeds, the site-specific production capacity,
- ii) the collection of endangered species will not be allowed but their controlled *ex situ* production will be promoted, and
- iii) the processing of MFP must not cause industrial pollution

(B) MFP in Social and Rural Development

- i) the priority to get MFP collection permits will be given to poor communities which may further allocate them to poorer members of the community,
- ii) communities which practice multipurpose forestry and incorporate MFP into their forest management schemes will be supported by the State,
- iii) backward tribes will have priority in the allocation of State forest for MFP production, and
- iv) cottage industries and the processing of MFP in rural areas will be entitled to support by the State.

(C) Contributions to Local and National Needs

- i) the collection and cultivation of edible and medicinal plants which are consumed locally are tax-free. Other commodities may be taxed locally. The sustainably produced surplus can be exported, and
- ii) the import of commodities which can be sustainably collected or produced in the country will be licensed.

(D) Economic Aspects

- i) the transport and processing of selected MFP will be deregulated,
- ii) research and development of MFP will be supported by the State, and
- iii) the primary collection of the commodities will be tax-free, but value-added industrial processing will be subject to taxation.

Changing Direction of Forestry to Suit Present Day Needs

R. Rajamani

The rapid depletion of forests and other natural resources today has become a serious concern of all mankind. The pools of biodiversity which forests represent has been instinctively realised over generations in our country and our forebears knew not only to create gene pools which they called by several names like Devarakadu but also recognised more practical uses like correlation with good weather, soil and water conservation and so on. Knowledge about the role of Carbon sinks is perhaps more recent but this is one of the features which has triggered off a world debate on the need to conserve trees and forests and mitigate global warming.

There is now general recognition that various ecological processes, such as those associated with sustainable productivity and biological diversity, permeate our land and water regardless of actual or designated uses. There is also a decreasing resource base and increasing demand for all forest goods and services. The reduction of forests and indiscriminate tree felling are leading to recurring floods, droughts, desertification, soil erosion, loss of biodiversity, scarcity of fuel and fodder and loss of a variety of forest produce which contribute valuably to the rural economy. The present scenario of exacerbated rural poverty and depravation in the tribal belts may to an extent be attributed to non-sustainable or overuse of natural resources particularly forests.

The advancement of biological sciences has enhanced our understanding not only of the irreversible damage caused by severance of life links but also the real value of sustainable utilisation of a number of products from our forests and trees. The respiration process and release of greater quantities of oxygen has now been finally established as qualities of trees. Science has increasingly helped in the realisation that nature and its biodiversity is integral to our existence and well being and that a tree standing is worth more than two trees felled.

The ubiquitous wood is better recognised as a forest product contributing to our economy even though other forest produce (non-wood produce) has a greater role in the existence and prosperity of the common man and perhaps also provides raw material for luxury products. It is this feature of yield of nutritional and other products of daily use like oils, fruits, nuts, honey, fibre, medicines, etc., that made people in our country to realize the value of standing trees and in

some cases like *Ficus religiosa* even worship them. The common among the forest produce of socio-economic importance are fodder, bamboos, rattans, gums, resin, leaves, oils and fruits. Their contribution to the economy is largely unquantified as a lot of such production is locally consumed by the population. The harvesting and utilization of many forest produce which are not handled by the organised commercial sector and mainly confined to individual enterprise for meeting day to day needs, have failed to attract the attention they deserve relegating the scientific management of such valuable resources to the background. The forest produce have an edge over the wood products in being able to contribute more towards return from investments in the forestry sector because of their shorter gestation periods and production cycles.

The adverse after effects of synthetic drugs, tonics, cosmetics, etc., has provided a market to big pharmaceutical concerns for products based on plant products. Popularisation of herbal products and the vast market potential for them nationally and internationally further threaten the existence of many plant species. The old medicinal systems of the orient are witnessing a renaissance. The growing demand for medicinal herbs from forests have the potential of generating large scale rural employment for the poor masses. The cultivation and processing of forest based medicines simultaneously provide industrial opportunities in production of value-added products from forest resources. It is estimated perhaps conservatively that the forest produce provides nearly 1.2 million man years of employment amounting to 55 per cent of total employment in forestry sector, excluding employment opportunities in grazing, collection of grass and fodder which totals to nearly 8 million man years of employment.

The National Forest Policy of 1988 incorporates, as a basic objective, the conservation of the natural heritage of the country, by preserving natural forests with its flora and fauna representing a remarkable biological diversity and genetic resources of the country. The policy also directs protection and enhanced production of forest produce (described in the policy as minor forest produce though I believe they are really major forest produce). This gives sustenance to tribal population and other communities residing in and around forests, in conservation and management of forest resources and increasing productivity of all forest produce by application of modern scientific and technological methods and survey of resources for scientific management of forest produce previously not considered important and the efforts towards survey, documentation, occurrence and quantification of which were considered insignificant.

Trees have been used since times immemorial by different ethnic groups in a variety of ways including as remedies for ailments, as insecticides and pesticides and keeping injurious insects away from human dwellings. The oil yielding species have catered to requirement of fuel, lighting and even medicine or products like cocoa butter. The nutritional value of most species of trees is well

recognised by village communities who for generations have treated honey as an important forest produce. Fibre from plants in forests, edible bamboo, nuts, fruits, berries—the list of Nature's benediction on us is endless. The documentation and identification of useful species generating forest produce and their conservation *in situ* and *ex situ* is a major task before the researchers. The *ex-situ* conservation, regeneration, cultivation and multiplication practices of identified species further invite detailed studies on their growth cycle, flowering period, seed peculiarities, response of vegetative propagules to multiplication and analysis, quantification of active ingredients to ascertain the best provenances. Some of these useful trees with an enlarging demand need standardisation of cultural practices for commercial cultivation and extension of cultivation practices among tribals and rural poor.

The potential of forest resources in contributing to the rural economy and in particular to that of the poor masses associated with the forest is immense. Only an all-round and systematic research effort at their conservation, cultivation, improvement, harvesting, processing, adding value at the doorsteps of the tribal, collection and marketing can translate their economic potential in improving the common man's economy.

The forest produce has to play a pivotal role in the quest for a new balance between protection of environment and economic development. Today international public opinion is beginning to consider the production of goods as less important than biological diversity, soil conservation, intervention in the water cycle and concern for the climate. None the less, forestry management that does respect all the roles played by the forests is very costly and upto the present use of forest produce is and will remain important in generating employment and improving economy of rural masses while preserving ecology as the trees will stand and only annual increment taken out.

Conservation of forests should not imply depriving people of their customary rights to resources essential for their livelihood, as in the absence of employment and incomes such people could fall deeper into poverty, thus provoked into subverting the forest developmental programmes. All forestry programmes must contain an explicit action oriented sociological foundation in which people are considered an integral part of the solution to the sustainable development of forests. The strategy should therefore be on participatory management as we have recognised in recent years and this could only succeed when those responsible for the execution of the forestry development programmes and the targeted population share and cherish a common goal mutually supportive of each others views and action. The developmental programmes must be founded on a sound technology and fulfill the economic aspirations of the people. The scientists, economists and marketing experts of forestry research institutions and elsewhere have a vital role to play here. They must develop new and economical technology packages for increasing production of forest produce, its efficient

processing and utilisation, etc., and improve marketing to assure remunerative returns for the people dependent on them for their livelihood.

This approach will reduce the pressure on the forests and further environmentally friendly techniques of management and utilisation, improve the economic and social status of people by promoting the creation of jobs, shelter and energy as well as the production of value-added products, maintaining biodiversity and sustainable production. Forestry research should be driven by powerful engines which are based on new forestry resources, no discrepancies between resource quality and market requirements, processing for value-addition and respect for environment. Forestry researchers and managers, whether concerned with ecology or economy, have the responsibility of advancing an understanding of these complex systems. A constant effort to inform, explain and to actively participate in forest produce development is essential. Forest produce development should help in poverty alleviation, conservation of biodiversity, sustainable development and finally ensure our survival.

Non-timber Forest Products—Policy Issues

N.C. Saxena

INTRODUCTION

Traditionally, the two broad categories of forest products have been timber and non-timber products. Since the forest department is custodian of all forest lands, it is virtually the monopoly producer of both type of goods. Conventional calculations measure potential of forest lands in terms of production of timber only. For people living near forests, many non-timber products, like leaves, seeds and fruits are more important. These “Boners” forest products as they were misleadingly known, and now called non-timber forest products (NTFPs), provide subsistence and income, especially during the slack seasons, as these are the source of a major portion of their food, fodder, fruits, and medicines. Then, the collection of NTFPs is a source of cash income, especially because of their increasing commercial importance. Of the total wage employment in the forestry sector, NTFPs have accounted for more than 70 per cent. More important is the opportunities for self-employment that these provide to the forest dwellers.

A study conducted by Operations Research Group shows that these products are essentially collected by tribal households and form an important part of these income. A study conducted by the Administrative Staff College of India, Hyderabad, indicated that agricultural production from tribal lands is inadequate to maintain a household at subsistence level, and hence they mainly depend on NTFPs collection. The average income realised through the sale of NTFPs by households in the state of Madhya Pradesh constitutes 34 to 55 per cent of their total income. There is thus sufficient evidence to believe that NTFPs collection constitutes a crucial part of life support system of people, specially tribals.

Poverty in India is generally considered to be linked with lack of private land, or its low productivity. Changes in collection of free items from forests go largely unnoticed, and are not accounted for in GNP. However, much of the misery of tribals and forest dwellers is due to deforestation which removes the resources on which their livelihoods has been based (Dasgupta, 1988). For instance, tribals in Koraput District of Orissa, earlier used, to depend for eight months of the year on forest products, but now (1988) with the depleted forest resources, their survival is threatened (*Indian Express*, April 3, 1988). Loss of

forests has also increased the pace of migration of tribals to the towns where they become low paid wage labourers (DN, 1988).

PROBLEMS IN GATHERING

Scientific forestry in India has meant raising trees in order to get sustained yield of timber for markets in perpetuity. Although rights of collecting fire-wood and other products are fairly extensive, well documented in Forest Settlement Reports and have not been curtailed by the successive state governments, yet in actual practice the poor may not be able to derive much benefit for three reasons

First, government has created new rights of industrialists through long-term agreements to supply forest products at a low price. Second, forests “burdened” with people’s rights are generally more degraded, and have little to offer. Third, people are far from fully informed about what they can legally collect from forests, and what is prohibited. There has hardly been any attempt by the Forest Department to publicise peoples’ rights; partly due to the fear that it would aggravate degradation, and partly due to the administrative culture of the Forest Department of keeping the people in dark. It suits traders and petty officials if tribals are not aware that they were entitled to collect NTFPs. Dapubai, a tribal woman in Udaipur got only Rs 7 for 10 kg of gum, which took her 10-12 days to collect (Bhatt, 1988), although its market price was Rs 250. When asked to comment on the low price, she said, “How can I demand a higher price? The trader’s man threatens to report to the Forest authorities about my entry to the forest area. Then we will get nothing”.

The ability of tribal people to enjoy their rights in forests is insecure when they are so uncertain what they are. But informing them is not considered politically desirable, whereas keeping the poor ignorant of their rights and leaving them to the mercy of the low-paid forest staff is perceived as politically neutral. Such is the irony of the Indian political system!

NATIONALISATION

Almost all important NTFPs are nationalised, that is, these can be sold only to government agencies. The nationalisation of these NTFP commodities, done in different states in various years from 1960s to the end of 1970s, presumably with the intention of helping the poor, has affected their interests adversely. Nationalisation reduces the number of legal buyers, chokes the free flow of goods, and delays payment to the gatherers, as government agencies find it difficult to make prompt payment. This results in contractors entering from the back door, but they must now operate with higher margins required to cover uncertain and delayed payments by government agencies, as well as to make the

police and other authorities ignore their illegal activities. This all reduces tribals' collection and incomes.

A Government Commission was told (Bhatt, 1988) by the tribal women in M.P. that when they walked a long distance to the office of the Forest Corporation to sell their produce, they often found it closed, or were told to come the next day. This forced the tribals to sell to the traders at only 20 per cent of the government price.

Before nationalisation, the tribals could sell the produce of their own trees to anybody, but under the new system, produce from trees on private land has to be sold to the Forest Department only. In almost all cases, the Forest Department has appointed agents formally or informally (GOI, 1987). This has put the tribals at the mercy of two different sets of people, the contractor as well as the government department, and whatever payment that tribals get has to be routed through both of them. Private trade in sal seeds is illegal in M.P., but shopkeepers manage to exchange it with tribals for daily necessities at a low price. They then sell it to government bodies, thus defeating the very purpose of nationalisation (GOI, 1988). This results in delay, and makes tribals indifferent to trees on their own private land.

PROBLEMS IN MARKETING

The sale of most NTFPs is done without any processing or value-addition. The producers' access to consumers is limited to the sale made in local villages and weekly markets. A major portion of their products is sold to intermediaries like contractors and commission agents who operate in the area. Thus, although these products reach a very large market, the market is geographically very limited as far as producers are concerned.

The limitation in access to market is more pronounced in the case of items like handicrafts made from wood & bamboo, toys, lac products and leaf plates. Except for a small demand in nearby villages for specific items, the rest of the market is geographically dispersed over a wide area and for most of the small manufacturers, remains inaccessible. This is more true for women entrepreneurs. Burdened with other roles within the family traditionally assigned to women, their ability to look for far-off markets is restricted. The small size of production further aggravates the problem forcing the producers into a vicious circle of a small market, low production and (leading to) small surplus. The limited surplus makes them more vulnerable and makes their exploitation possible because it continuously erodes their bargaining capacity as their need for conversion of small production into cash becomes more acute.

The limited access to markets and the dependence on intermediaries have a direct effect on prices. The price of a produce—whether sold to consumers or to the intermediaries—bears no relationship to the cost of labour, input and

transportation. In the case of direct sales, three factors combine to depress the prices. Localised activity for localised markets create a supply position in excess of local demand. Traders in the same commodity control the market and dictate the prices during the season and in the off-season. The third factor is the selling of the produce during flush season and the purchase of same produce in the off-season.

In the case of sale to intermediaries, the situation is worse, the producers having absolutely no control on the prices or the quantity. Studies show that the poor producers' income always remains low.

DIVERSION OF NTFPS TO INDUSTRIES

Some NTFP items, like sal seeds, have become important for industry. This reduces the consumption of NTFP as a staple food and medicine for the tribals, especially when the total supply from forests has declined because of deforestation (Fernandes *et al.*, 1988). As their consumption declines they are forced to borrow more, and at a high rate of interest from money lenders, for buying food grain. Then even if they would like to consume minor forest produce, they are not able to do so as pressure from moneylenders forces them to sell.

Sometimes industries, in order to maximise the collection of NTFPs, use methods which are destructive to these plants. An obvious example is extraction of resin from pine trees. In tendu tree areas, contractors slash all undergrowth to promote a better growth of tendu leaves. In the process, many fruits, roots and medicinal plants get destroyed. Besides, it causes soil erosion (Dasgupta, 1986). Where industries hold bamboo leases they utilise even the better quality bamboo for pulp, although according to rules only inferior quality bamboo should be used as pulp, and the better quality should be sold to artisans. Furer-Haimendorf (1985) describes how a particular paper mill exploited bamboo in a tribal region by bringing in hundreds of labourers from different states and used methods of extraction which endangered future regeneration.

LACK OF PROGRAMMES FOR NTFP REGENERATION

Regeneration of NTFPs has attracted only a token effort so far. There has been little or no place for NTFPs in social forestry schemes. The 7th plan target for NTFP planting was only 85000 ha., as against a total afforestation target of 9 m ha for the five year period. In Orissa, where dependence of the tribals on NTFPs is quite high, only 4 per cent of the trees planted during 1986-87 were NTFP species (GOI, 1988). Large scale propagation techniques for important NTFPs like tendu and mahua are still to be developed. Many NTFPs require a period of 18 months to 2 years at the seedling stage, as opposed to 3 to 4 months for *Eucalyptus* and *Acacia nilotica*, which are the main social forestry species.

This discourages the social forestry staff burdened with targets to achieve from promoting NTFP species.

POSSIBLE SOLUTIONS

Of the several roles, tribals, women and the poor have in forestry, the most important is as gatherers of forest produce. They would therefore be greatly benefitted if opportunities for collection from forest and public lands are enhanced. This would require:

- i) a change in the silvicultural practices of managing forests,
- ii) a change in the nature of species being planted on public lands from timber to usufruct based trees,
- iii) sharing of management and protection with forest dwellers,
- iv) publicity about their rights in forest and community lands, and
- v) a change in outlook to facilitate the above.

These are discussed below under silvicultural practices, change in species on degraded lands, primacy of rights, changes in forest laws, and change in attitudes.

Silvicultural Practices

Forests have been traditionally looked upon as a source of revenue and not as a means of meeting the genuine needs of the people. That is why the entire thrust of forestry has been towards the high forest system, which calls for clear felling and ruthless cutting back of all growth, except of the species chosen for dominance. This has the major defect of creating a bias in favour of coppice origin plants which, in the long run, are more amenable to biotic and climatic factors, and secondly, it results in the removal of all the material which could serve gathering needs. The high forest system has resulted in pure forests being created, but with gathering falling a casualty in the process. It is in this context that a major policy change is required.

A start could be made by deciding that gathering is a legitimate and genuine expectation of the people and that if they are not allowed to gather, they will treat the forests with hostility. What is now termed as biotic interference, i.e., foraging for fuel and fodder, grazing, removal of bamboo and small timber, should be looked upon as a logical and appropriate working of the forests. This calls for an abandonment of the existing silvicultural practices, not so much to achieve high forest as to restore to the forests an admixture in which the appropriate level of vegetation would be available to meet gathering needs. An immediate identification of quick growing shrubs with high calorific value, with their retention in the forest to serve fuel requirements, the development of pastures, i.e., giving over adequate forest land to grasses, and the development of

massive fuel-wood plantations around centres of high consumption and encouragement of silviculturally sensible exploitation of fuel-wood species would also be important components of the new policy.

Only over-mature, mal-formed, dead or dying trees should be removed, with no particular reservation by species. Ground flora and the understorey should be largely left undisturbed, except for the improvement of hygiene of the forest flora through removal of noxious weeds. The crop would be representative of all age groups because no attempt would be made to achieve a uniform crop in terms of variety or age. In those areas where teak and sal are the naturally dominant species, they would continue to predominate even without silvicultural intervention to achieve a uniform crop. However, because of age and species mix the forests would be able to maintain a continuous supply of miscellaneous small timber and fuel-wood for use in gathering. Commercial working would taper off because clear felling by blocks would be totally abandoned, but there would be some production of timber from the over mature trees that would be felled.

Change in Species on Degraded Lands

Social forestry concepts should be extended to degraded forest lands by changing the nature of species from planting of commercial species to natural regeneration or planting of usufruct based trees, such as neem, mahua, sal, arjun, and tamarind. These should be supplemented with grasses, legumes, shrubs and bushes to yield fuel-wood and fodder in the shortest possible time. This would strengthen tribals' access to forests, and therefore benefits would be directly appropriated by them. Unlike commercial timber species, relatively low value non-rotational trees for recurrent products would not so much attract the attention of powerful panchayat leaders and contractors.

Species have been so far based on convenience of staff rather than needs of people. People have not been asked what trees they prefer, least of all the poor. Socially useful species producing fruit, fodder and other NTFPs have had little place. Market oriented species like *Acacia nilotica*, *Acacia auriculiformis*, and *Eucalyptus* spp. have been preferred (CIDA, 1988), even in Community Forestry Schemes as they are non-browsable, can grow fast, and require little management. Possible use of other species either in overhead mixture or as understorey has not been seriously considered. Spacing has often been reduced to avoid intermediate management operations, to reduce plantation cost, and to cut down on staff supervision time. In Gujarat, the density of plantation per ha. on village woodlots was as high as 2554 (IIPO, 1988). As a consequence, spacing, thinning and pruning which could have produced intermediate yields of grass and tree products for the people have not been made use of (Banerji, 1986). For instance, Forest Department's present management of sal seems to

be for timber, and hence only one shoot is allowed to grow. Since sal is an excellent coppicer, we suggest that degraded forests and hills close to a village should be managed to maximise biomass, with many shoots, which can be pruned occasionally to produce fuel-wood. Coppicing or clear felling after 7-10 years may produce income to the panchayat or to Government but village consumption of tree products is little increased. Technology with which the foresters were familiar for large scale plantations for markets within forest areas was applied to small scale village woodlots, where the need was more for fodder and subsistence than for timber.

Foresters and foreign experts who advise the GOI and the donor agencies, because of their training and experience, have looked upon trees as timber, to be obtained after felling. Therefore, even in the social forestry programmes market oriented species were planted. The traditional Indian way of looking at trees has, however, been different. As opposed to trees for timber, Indian villagers for centuries have depended on trees for their livelihood. There has been little felling. Instead, trees have been valued for the intermediate products they provide, which sustain and secure the livelihoods of the people.

The difference can be understood by comparing how fuel-wood species are viewed in the two perspectives. As per received wisdom, fuel-wood is obtained by felling trees having a high calorific value, or as a by-product from lops and tops of timber trees. *Casuarina* and *Eucalyptus* therefore seem perfectly justified on public lands. But the poor tribals obtain fuel-wood from twigs and branches of living trees, and not by felling trees, and often get little from the felling of so-called fuel-wood trees. *Casuarina* and *Eucalyptus* may be justified on farm lands, if they improve farm incomes on a sustainable basis. But these hardly serve the poor, when raised on public lands.

Given the inefficiency of administration and 'soft' character of the political system, one could generalise that out of a tree on public lands, the stem goes to the rich in the towns, whereas branches, leaves and twigs belong to the poor. Therefore the strategy should be to opt for species which have high proportions of branches and twigs relative to stem wood. This requires a complete reversal of the recommendations of the National Commission on Agriculture, 1976, which favoured commercial plantations on forest land, and trees for consumption and subsistence on private land (Saxena 1990). Our recommendation is that subsistence and consumption should be met from forest and common lands, and market demand should by and large be met from private land. Using private lands for short rotation products will permit the large area of forest lands to be used for long gestation trees, which enrich the environment and provide a range of products to the poor. For quick benefits to the poor, long gestation trees would be supplemented with an understorey of bushes and shrubs so as to satisfy immediate needs of the poor. "Scientific" forestry should therefore mean that wild fruits, nuts, NTFPs, grasses, leaves and twigs become the main

intended products from forest lands and timber a bye-product from large trees like mahua and sal. The reverse has been the policy for the last 100 years. Although after the advent of the new forest policy in 1988, there has been some effort to involve forest communities in management, no thought has been given to make necessary changes in the technology which will be suitable to the changed objectives. The proposed changes are explained in brief in Table-1.

Table-1: Technical Options

		Old	New
1	objective	reduced people's dependence on forest lands	increase supply of goods desired by people
2	'look' of the forest	stem based	crown based
3	client	market & industry	forest dwellers & local people
4	timber	main product	bye-product
5	silviculture	conversion to uniform	improvement felling and protection
6	species	exotics & commercial	grasses, bushes, shrubs & MFPs
7	production through	planting	regeneration
8	usage through	harvesting	gathering

Primacy of Rights

As already pointed out, tribals' rights of access and their right to collection of forest products are restricted, vague, or not known to them. Sharing arrangements in Joint Forest Management or community forestry schemes are ill-defined or not publicised, or poorly implemented. There appears to be general reluctance on the part of the government to define clearly what people are to get, at what time, and at what price, in exchange for the participation expected of them. But participation of the poor and tribals is improbable unless their benefits are secure.

Therefore, we suggest that outside each forest coupe or social forestry plantation there should be a notice board publicising what rights people have as regards to collection. The colonial tradition of secrecy must be given up. A simple notice that, "these trees belong to the community, and not to Government", may in itself, change peoples' attitude towards village plantations. Agreements must be entered in writing with the beneficiaries informing them about their entitlement, and copies given to each village.

Similarly, nationalisation of NTFPs, justified in the name of preventing tribal exploitation, creates excellent opportunities for private traders and bureaucracy to extract suitable rent for "services rendered". Practical considerations point out that Government is incapable of effectively administering complete control. It is better for Government to regulate private trade, and to act as a watchdog

rather than try to eliminate it. Monopoly purchase by Government requires sustained political support and excellent bureaucratic machinery. It is difficult to ensure these over a long period and hence nationalisation has often increased exploitation of the poor. We suggest that for marketing NTFPs, Government should not have a monopoly. The solution is to set up promotional Marketing Boards, as distinct from commercial corporations (which are inefficient, and hence demand nationalisation), with responsibility for dissemination of information about markets and prices to the gatherers. The Boards would help in bridging the gap between what the consumers pay and what gatherers get. We would be quite happy if government organisations could compete in the open market, as in the wheat purchase scheme, but government should never acquire a monopoly. Nationalisation reduces the number of buyers and does not help gatherers in the long run. Setting up processing units within the tribal areas is also to be recommended.

Changes in Forest Laws

There are a number of contradictions in the new Forest Policy and the amended Forest Conservation Act, both of which were enacted in December, 1988. These are summarised in the Table-2 given below.

Table-2: Contradictions in the New Forest Policy

Provisions of the Policy	Contradicted by
Minor forest produce should be protected, improved and their production enhanced (section 3 5)	Forest Conservation Act prohibits plantation of horticulture crops, palms, oil bearing and medicinal plants on forest lands, unless prior permission of the Government of India has been taken
Degraded lands should be made available on lease or on the basis of a tree patta scheme to individuals and institutions (section 4 2 4)	Forest Conservation Act bans assignment or lease of forest land to the people or institutions not wholly owned by government
Rights and concessions enjoyed by the tribals should be fully protected (section 4 3 4 3)	Rights and concessions, including grazing, should always remain related to the carrying capacity of forests (section 4 3 4 1)
Domestic requirement of tribals should be the first charge on forest produce (section 4 3 4 3)	MFPs and substitute materials should be made available through conveniently located depots at reasonable prices (same section)
Land laws should be modified to facilitate individuals to undertake tree farming on their own land (section 4 2 4)	Appropriate regulations should govern the felling of trees on private holding (same section)

There are two provisions of the amended Forest Conservation Act which need to be taken note of. First, it bans assignment or lease of forest land to the people, and second, it prohibits plantation of horticulture crops, palms, oil

bearing and medicinal plants on forest lands, unless prior permission of the Government of India has been taken. These provisions should be read with the new Forest Policy, which looks down upon gathering of forest produce by stating that “these (MFPs) and substitute materials should be made available through conveniently located depots at reasonable prices”. It also wishes to curtail the rights and concessions of forest dwellers by relating them to the carrying capacity of forests.

The operative section 2 (iii) of the Act (after amendment in 1988) reads as follows:

“No State Government or other authority shall make, except with the prior approval of the Central Government, any order directing that any forest land or any portion thereof may be assigned by way of lease or otherwise to any private person or to any other authority, corporation, agency or any other organisation not owned, managed or controlled by government”

This new section contradicts section 28 of the Indian Forest Act, which states,

“Formation of Village Forests-1) The State Government may assign to any village community the rights of Government to or over any land which has been constituted a reserve forest or declared a protected forest or is a forest belonging to the Government and may cancel such assignment. All forests so assigned shall be called village forests”

The new amendment nullifies the entire concept of village forests provided for in the Indian Forest Act. The rationale for keeping section 28 in the Forest Act was the realisation that villages can better protect lands which are close to the village, and only land far away from habitation was to be brought under government control. In pursuance of the powers given to the states under this section some states had transferred forest areas to village bodies for protection and management. These Rules too have now become null and void, and thus the existing legal basis for encouraging people's participation has been wiped off.

Similar ambiguous position exists regarding species choice. The new Act discourages planting of horticulture crops, oil-bearing plants, palms, and medicinal herbs on forest lands. Although there is a good case for banning crops like oil-palms in Andaman and Nicobar, or apple in Himachal Pradesh on forest lands, yet reading this clause with section 2 (iii) gives rise to a suspicion that all usufruct based trees, which attract people to the forest areas, like ber, mahau, neem, karanj, palmyra, tamarind, jamun, and several medicinal herbs would not be permitted now. This shows total insensitivity to the needs of the tribals and forest dwellers. Already a large number of such livelihood trees have been replaced by monocultures of teak, eucalyptus and pines. This trend would get further support from the new Act.

Para 4.3.4.3 in the new Forest Policy relating to making forest produce available to the people from government depots amounts to banning the entry of

the people to forest lands. It can be criticised on three grounds. First, it takes away the fundamental and age-old rights of the people to gather India's forests are not uninhabited wildernesses; there are people living inside forests who under the new dispensation would have to travel miles outside their habitat to the government depot to buy essentials, which so far they got free. Second, the new scheme further strengthens the petty officials, who would get new powers to harass the forest dwellers. And third, given the poor condition of state funds, the scheme would not be able to get enough subsidy, and hence supplies are unlikely to be available at a price the poor can afford

The objective seems to be that Government wishes to have exclusive monopoly rights to management and ownership over forest lands, both reserve and non-reserve. It does not trust the poor, and hence would not permit growing of trees like mahua and mango which attract the poor to forest areas. The mid-term evaluation of Social Forestry Projects by a World Bank/ USAID team revealed that even where the programme for regeneration of wastelands through tree patta schemes is intended on road strips, (as in U.P. where road strips have been declared as protected forests), or unclassified forests (H P), the programme has been held back due to lack of permission from the Government of India

The new Policy expresses concern for ecology, but read with other provisions and the Act, it appears that environment is being used as a new excuse to keep people out of forests, just as "vital industrial needs" were considered enough of a justification to deny legitimate aspirations of the poor in the past

Although it appears that these new draconian laws are not being implemented rigidly, as usufruct sharing schemes are being promoted by the GOI itself, and the GOI has also clarified that fruit species, etc., could be permitted, but the power of harassment of NGOs by state officials under the grab of enforcing the Forest Conservation Act is immense. Further, who knows a more "conservation" oriented bureaucracy at the centre tomorrow would not wake up to realise the powers given to them by the new Act! Lastly, as is well known, the legal enactments reach all sections of bureaucracy, but benign circulars favouring people have a habit of disappearing fast before they reach every one. This will further delay the execution of people oriented schemes in forestry sector

Change in Attitudes

Government of India and the State Governments spend millions of rupees in the name of tribal upliftment. However, tribal policy and forest policy, despite the rhetoric, have never been integrated so far. They run on parallel tracks. Whereas the policy in Tribal Development is to give new skills and assets to the tribals, the Forest Conservation Act wishes to reduce access of the poor to whatever they could get from forests in the past. By denying to the people any role in

forest management and share in forest produce it reduces the concept of peoples' participation to a mere rhetoric. These tend to define forest-people interaction as a zero-sum game; forests can be protected only when people lose, and any gain to the people is at the cost of forest protection. In this scenario, both lose. The challenge is how to convert this into a win-win game.

One problem which will be encountered, if the suggestions contained in this paper are to be implemented, is the attitude of IAS and IFS officers, who associate "development" with spending of money, or with setting up of new organisations (which they head, of course!) Changes in policy or nature of species or laws are not seen as integral part of the development process because these have no direct financial implication. Non-monetary inputs in policy have unfortunately no ready acceptability in government. The Indian civil servant has still to learn the difference between planning and budgeting. S/he is looking for a scheme rather than a new policy framework. The question, however, is whether we wish to help hundreds through projects, or millions through changes in policy.

This is possible only when, 'productivity', 'yield', and 'economic value' are redefined in terms of multipurpose utilisation and satisfying basic human needs. This requires a new outlook and a new strategy, in which poor's interests, of giving primacy to production of NTFPs and, of secure rights of gathering would be paramount. Livelihood needs of the poor are preconditions for sustainability of natural resources.

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Forest Management Planning for Multiple Objectives: NTFPs in JFM*

Jeffrey Y. Campbell

THE CHALLENGE

Joint forest management represents a unique opportunity for involving communities in the management of non-timber forest products, on which so many people depend. The challenge before forest managers, whether they are from the local community or the forest department in implementing joint forest management is extremely exciting. Once the initial institutional and social issues have been addressed and community protected forests begin to regenerate, the critical issue of how they should be managed has to be addressed. Old management practices usually biased towards either maximizing revenue and a single product, timber or towards strict conservation may not be appropriate. Basic assumptions about uniform silvicultural prescriptions need to be re-examined and due recognition to the importance of non-timber forest products must be given.

NEW QUESTIONS

A variety of important questions need to be answered. How does one arrive at a negotiated set of management objectives in a participatory and equitable manner? How does one evaluate and experiment with a mix of silvicultural practices? How can one maximize fodder, fuel-wood, and a range of non-timber forest products as well as timber from a small forest patch and turn out the optimal mix of economic flows? Can a steady supply of fuel-wood and fodder be produced for both subsistence use? Is it possible to sustain a certain amount of fuel-wood cutting for sale as well, and still allow other forest management objectives to be addressed? What level of grazing intensity is acceptable in different stands? How does one establish sustainable harvesting systems for so many products? How can the ecological health of the forest be improved if extraction rates are intensified for different products?

* An expanded version of this paper has since been co-authored with B M S Rathore and will be appearing in the Wasteland News

COMPONENTS OF INNOVATIVE MANAGEMENT AND SILVICULTURE

Management and silvicultural innovation for Joint Forest Management (JFM) must incorporate the following factors.

- i) - participatory objective setting negotiated forest management objectives, combining community and national needs;
- ii) - Participatory silvicultural planning: combining indigenous knowledge with technical principles and experience,
- iii) - multiple objectives and multiple products this requires an understanding and evaluation of economic and ecological trade offs, especially the appropriate mix between timber production and NTFPs;
- iv) - multiple management time horizons silviculture will have to consider monthly, seasonal, annual, periodic, short and long term harvests and rotations,
- v) - management prescriptions will need to be applied on more site specific basis to JFM forests, calling for a compressed geographic focus with dramatically reduced coupe sizes and mini-felling series,
- vi) - corresponding landscape level linkages will need to be maintained between JFM patches at a forest cluster level and beyond – to maintain biodiversity, corridors and seed sources;
- vii) - maximization of growing space: exploiting forest architecture to maximize production of different canopy layers including shrub, and herb layers, as well as forest floor management;
- viii) - encouraging natural regeneration and mimicking natural forest ecosystems in plantations and afforestation,
- ix) - individual plant manipulation. pruning, lopping, pollarding, ratooning, weeding, protecting, micro-site amelioration, soil and moisture conservation, etc ,
- x) - participatory implementation of intermediate operations, harvesting and marketing procedures,
- xi) - innovative grazing and fire control systems,
- xii) - flexible, decentralized planning and budgeting at the operational level, particularly linkage with working plans, project and scheme budgets based on macro level prescriptions and planning, and
- xiii) - increased accountability and equitable benefit sharing

PARTICIPATORY APPROACHES

How can foresters and local community managers sit together and effectively plan new silvicultural management systems? Recent experiences with

participatory rural appraisal (PRA) methods show that these can be very useful in helping communities plan collectively. A number of techniques have been developed to help people list, rank and score the importance and utility of different species and products from the forest. These need to be extended to help in the evaluation, discussion and monitoring of different silvicultural operations. Once needs for forest products have been determined to a reasonable extent, these can be prioritized into management objectives. A bargaining process of objective setting needs to be developed both within the community where different needs may have to be prioritized, and between the community and the forest department, as each must be ready to relinquish or reduce its own objectives. A considerable amount of work has already been done on different methodologies for assessing NTFP volume flows and values.

Some Suggestions for Assessing NTFP Volume Flows and Values

Activity	Method
1 Priority Ranking of Forest Products (rank by category, i.e., commercial, edible, medicinal, construction, fodder and compost) (Note products which are no longer available, or with declining or increasing availability)	Group Interview with Community Forest User Groups (by gender, caste, etc.) Ranking Matrix Group Interview (Trend Lines)
2 Document important NTFP culturing, Collection and Processing Methods	Observation and Key Informant Interviews
3 Identify Forest Collection Area and Boundaries and Estimate Size-prepare Map	Sketch Mapping (Measurement if necessary)
4 Calculate Number of persons collecting NTFPs in Forest Study Area	Group Interviews (Household Survey if necessary)
5 Prepare a Calendar indicating the periods of important NTFPs availability. Calendar should describe the high and low yield periods	Group Interview Seasonal calendars by gender and different user groups
6 Estimate Time, Capital and Materials used to collect Commercial and Subsistence NTFPs	Key Informant Interview (Observation, Record Keeping) Daily or Weekly Activity Sequence
7 Estimate Amount of NTFP collected in each Forest Visit (note variation in peak and low yield periods) Estimate number of visits through out the collection period	Group and Key Informant Interview
8 Establish unit price for each NTFP (note seasonal variation)	Group interviews, Buyer interviews, Local market visit

Cross Checks

Check with local buyers and traders regarding NTFP production, volume and price in Study Area (Key Informant Interviews) (Poffenberger *et al.*, 1992).

How does this background on NTFP volume flows and values fit with the overall strategy for managing the forests? To try and stimulate community discussion about different management options, the following exercise has proven very useful.

COMMUNITY FOREST MANAGEMENT PLANNING EXERCISE

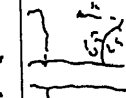
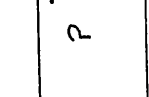
In this exercise, which draws on PRA tools, community members and the forest department collectively prioritize the most important forest based products/objectives. This is followed by a discussion of how the abundance and availability of these products has changed over time and in different forest conditions. In other words, people discuss the abundance of products when the forest was dense and lush (more than twenty years ago), when the forest was patchy, open and degraded (five years ago) and when the forest begins to regenerate following protection (at present). This leads to a more detailed discussion of the ecological characteristics and successional stages of the forest which favour the production and harvesting of different products. Based on priorities for different products and objectives, a set of silvicultural prescriptions can be discussed which would ensure that parts of the forest were managed to replicate favorable conditions to optimize productivity.

Recent applications of this exercise with several communities helping to regenerate sal forest patches in West Bengal gave rise to a mixture of suggested silvicultural prescriptions, based on a division of the forest into different zones. The overall effect was to create a mosaic of forest stands under different silvicultural treatments for different purposes. These included: a sacred grove/core area where no management or use would be allowed, in order to preserve biodiversity; a high forest zone where some selective felling of mature sal trees would be allowed for household timber, and a limited amount of sal seed and mushroom collection would take place; a felling series of coupes under different rotations (very short for fuel-wood and leaves, and longer for poles), and special management for certain species, such as fruit trees or tendu bushes. A more detailed discussion of different steps in the exercise is given below.

Step-1 Sketch out a rough historical transect which reflects major changes over time in forest vegetation and product availability. Extract the important time periods in the history of the forest and its use. e.g. (a period when the forest was in excellent condition, 20 years ago?), time of a major event such as a large harvest or other disturbances, the period of maximum use and degradation (5 years ago?), period of initial response following protection (now?). (Refer to Table-1 and Figure 1 for illustrations of different steps of the exercise.)

Step-2 Make a list of the most important forest products identified by the

Table-1. Participatory Forest Management Planning Matrix

Product/ Objective								Biodi- versity	Sustain- able use
20 years Ago When the Forest was dense	000 000 000 000	000 000 000	000 000 000 000	000 000 000	000 000 000 000	000 000 000 000	000 000 000 000	000 000 000 000	
5 Years ago before protection	00 00	000 000 000	000 000 000	000 000 000	000 000 000 000	000 000 000 000	000 000 000 000	000 000 000 000	
Today after protection	000 000 000	000 000 000	000 000 000	000 000 000 000	000 000 000 000	000 000 000 000	000 000 000 000	000 000 000 000	
Projected need	000 000 000 000 000	000 000 000 000	000 000 000 000 000	000 000 000 000 000	000 000 000 000 000	000 000 000 000 000	000 000 000 000 000	000 000 000 000 000	
Ecological niche/ successional stage									?
Management steps	thinning short rotation alternate sources	low sprouting coppice or sprouts	longer rotations for seed bearing and trees	shrubs root suckers pruning	long rotation high forest	high humous no leaf sweeping	total protection enrichment planting		

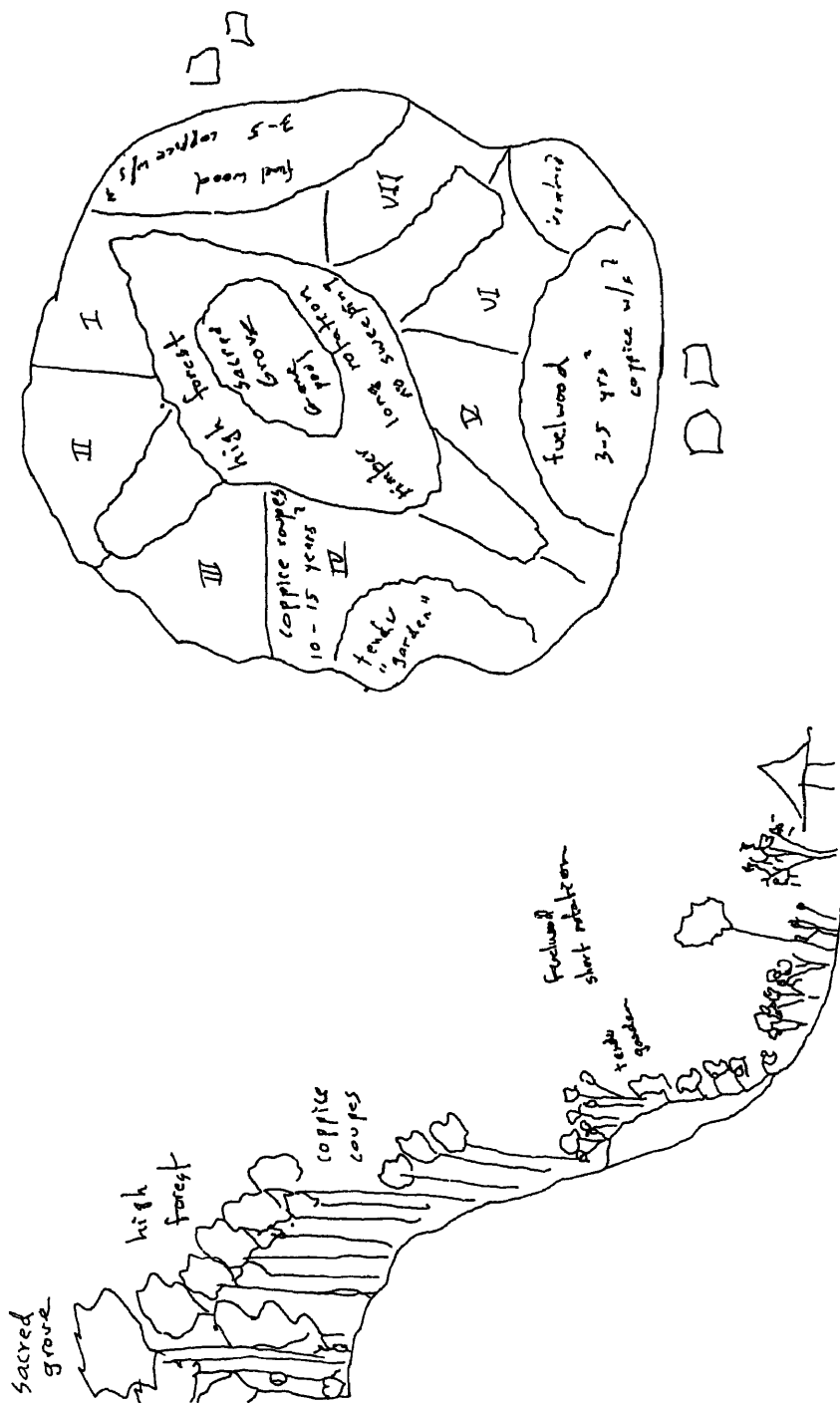


Fig. 1. Silvicultural Diversity

users. These are taken as forest management objectives. Additional objectives of the forest department, if different, may also be listed. Name these, or make a drawing of each product across the top of a large sheet of paper or on the ground. On the vertical axis list the major time periods which emerged from step-1.

Step-3 Ask community members to compare the yields and availability or incidence of collection and use of each product over time. This can be done by assigning 10 stones to each time period for each product and evolving a ratio. For instance if fodder is being discussed, have participants indicate the quantity of fodder (out of ten) that was available 20 years ago, when the forests were in excellent condition, 5 years ago when the forests were totally degraded, and now after five years of protection.

Step-4 Discuss the ratios that evolve. Some products may have been abundant or easily accessible like fodder grass for open grazing, or leaves for plates or bidis when the forest was more open and degraded, while others like large timber, or fruit or mushrooms might be more abundant depending on the age of the forest, or the soil conditions. Make notes on the ecological issues which emerge pertinent as to why certain products are more abundant at certain times or in special conditions.

Step-5 Create another line for demand for each product (don't put a limit on the number of stones, but specify that each stone has the same value as earlier). This should generate a discussion about the gap between supply and demand over time. Discuss how long the current forest needs to be protected in order to meet demands or to return to the condition it was in over twenty years ago. If it is quite clear that demand far exceeds supply then discuss what ratio could be sustainably supplied from the forest, and where alternative supplies could come from, and how this could be calculated and monitored.

Step-6 Create another line with boxes for management treatments under each product and list the kind of management needed for each product. e.g., some trees should be kept in a bushy condition, or in small diameter classes for the collection of leaves, for fuel-wood small diameter stems of coppicing species in the 2-5 year old age class may be considered ideal, for agricultural implements intermediate sized trees of certain species are needed, for seed and fruit bearing, trees need to reach a particular age and size, for household roofing and other timber needs, large diameter trees are needed. For mushrooms, moist soil conditions with plenty of organic matter and humus may be needed, for biodiversity preservation, some part of the forest should remain untouched. Have people sketch what the ideal forest stand would look like for the production of each

objective/product in a separate box. This should generate an interesting discussion on the trade-offs between different prescriptions and different needs – and perhaps generate another priority ranking exercise for different management options. A number of possible strategies may emerge for sequencing different silvicultural operations, for zoning and creating felling series, for product or species based management of individual trees and shrubs, for enrichment planting, and for protection.

Step-7: On a rough sketch map of the forest, chalk out zones most suitable for different forest management strategies and discuss the implications of different approaches. An idealized transect could also be drawn which illustrates prioritized proportions of the forest under different treatments.

Step-8: Conduct the same exercise separately with different user groups, men and women, and different occupational groups. Share the results in a general meeting and get comments from forest department officers. Options which people suggest under different objective headings could be discussed and options which foresters consider silviculturally viable, could be reviewed publicly. This requires discussion on the ecological needs of different species, and the overall structure and sequencing of the forest operations under discussion, which are complex issues. Discuss the practical issues of implementation of different intermediate and final harvest operations, who would do the operations, what are the economies of scale (when undertaking harvests of very small isolated coupes)? How does the forest management plan link with neighbouring forest areas and the patch or larger contiguous forest?

The process of discussing forest management options gave rise to a number of interesting findings:

i) The degree of attention which participants gave to establishing the correct ratio of product availability over time was very impressive. Participants constantly coached whoever was placing stones to represent quantities and revised the ratios until a consensus was reached on how forest productivity had changed. Men, women and different user groups within the community had different lists of products and different priorities within products. This makes it imperative to undertake the exercise with different groups and both genders.

ii) People quickly grasped the purpose of the exercise. 'This is the history of our forest.' 'This shows what we need to do to get back the good old forests.' In one session a long digression took place after the ratios were established when one woman intervened to say, 'First, we should discuss the reasons for these changes in the forest.' This led to an analysis of the history of forest use in the area and the causes of forest degradation.

iii) People had detailed knowledge about the successional stage and ecological conditions necessary for different kinds of products. This came out in various discussions, particularly with relation to the change in availability of products as canopies close, the soil and site conditions necessary for abundant mushroom production on the forest floor, or to the reasons why date palms were more abundant in degraded sites.

iv) People were able to suggest a variety of approaches for the manipulation of single tree and plant, and for sequencing some management operations. These included restricting forest use during certain closed periods, such as during the monsoon when new seedlings are regenerating. Some concerns echoed technical issues, such as the worry that older sal trees might suffer from heart rot, which they had learned from Forest Department Staff. It was clear however, that the community had not had the opportunity to contemplate management options for the forest as a whole, particularly in considering different options for sequencing harvesting operations for poles and timber. When discussing ways to resolve the conflict between the need for fuel-wood and cash (from short rotation pole wood harvests) versus the need for mature timber, seed and fruit bearing trees and biodiversity, one elderly participant suddenly struck on the idea of rotations, and a sequential felling series. Traditional knowledge and modern forestry methods found a meeting ground in this exercise, and

v) It was clear that this was the first time these people had really been consulted on the management of the forest as a whole. They were still unsure about whether their suggestions would amount to anything.

INNOVATIVE MANAGEMENT IS TAKING PLACE

A number of innovative foresters and forest communities are already addressing these challenges with exciting new approaches and practices. A number of stimulating presentations, papers and articles circulating in Indian forestry circles are beginning to discuss silvicultural issues related to NTFPs and JFM (Campbell, 1993, Chaturvedi, 1992a, 1992b, Guhathakurtha, 1992a, Shah, 1994a, 1994b, Pathan, 1994, Maithani, 1994, Lal, 1994, Rizvi, 1994, Saxena, 1994, Rathore, 1994 to name a few). Much more needs to be done to document these efforts and evolve dynamic, participatory practices to manage forests for multiple products, especially NTFPs.

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Non-timber Tree Products and Tenure in India: Considerations for Future Research*

Mark Poffenberger

INTRODUCTION

In India, non-timber tree products (NTTPs) are of immense, yet often unrecognized importance to the country's rural populations. For decades, government administrators referred to them as minor forest products (MFPs), reflecting their secondary status to timber. Yet, nearly 60 per cent of all recorded forest product revenues in India are generated by NTTPs, while unofficial estimates indicate the proportion is considerably higher. Most of India's 50 million tribal people receive a substantial proportion of their cash and kind income from NTTPs, while 200 to 300 rural Indians depend to varying degrees on products from the forest. While markets in NTTPs have existed for thousands of years, most are consumed in the home.

In recent decades there have been a growing interest in the markets for non-timber tree products among planners, donors, consumers, and producers. There is considerable interest in examining the market potential of NTTPs and the types of policy mechanisms that could facilitate the growth of this sector of the economy. Some environmentalists assume that the growth of NTTP markets will lead to a higher value being placed on the forest, encouraging its conservation, and that deforestation is primarily driven by poverty. Such thinking then concludes that economic growth fostered by better NTTP markets, will lead to greater environmental stability. These assumptions have stimulated some donors, non-governmental organizations, and research organizations to establish marketing studies and schemes to explore such opportunities. While these efforts are laudable, they seem to assume that markets are a primary determinant of resource use behavior and that better market prices and access will lead to more sustainably productive use. India's experience indicates that these assumptions do not hold up under scrutiny. This paper shares the sentiments of Dove (1993) that there is a danger in focusing research and intervention

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activities solely on the economics of NTTPs, since it "diverts attention and thereby masks the need for fundamental changes in political-economic institutions" While there is a great need for market studies of NTTPs, such research should be grounded in the socio-cultural and political economy which, the author argues, more fundamentally shapes human-forest interactions.

There is growing evidence that the controls, usufruct rights and tenure status of land, trees, and forest products are critical factors in determining the way in which users view their resources and manage them. Regardless of market demand levels, inappropriate tenure and trade policies and government imposed field level regulations often lead to poor management of forest products and low revenues for collectors. Unlike agricultural commodities, most NTTP's are produced on public forest lands for subsistence use. NTTP collectors often have few or no rights over this domain, and as a consequence their ability to control access, or intensify management through pruning, weeding, enrichment planting, or fertilization, is limited. In fact, because of the tenure conditions effecting public forest lands, local users have incentives to over-exploit NTTPs, gathering them as quickly and abundantly as possible, to avoid them being captured by other users.

As a consequence, on public forest lands, the unsustainable exploitation of NTTPs is often driven more by unclear usufructs and open access utilization, than by high market prices. Where NTTP producers generate such goods on private lands, they are often subject to overlapping regulations which affect the trade in many forest commodities. Consequently, any study of NTTP markets must be cognizant and informed regarding the larger political-economic environment in which forest management and trade decisions take place.

This paper will explore some of the broader forest management and tenure contexts in India within which NTTP use behavior and market patterns exist. In this paper forest tenure is defined broadly as the "bundle of rights", both written and unwritten, and the forest activities of insider and outsiders which shape users perceptions of their resource security. The author argues that local use of NTTPs is determined by local environmental conditions, knowledge and belief systems, and political forces, which are also influenced by government policies and programs, as well as outside market conditions. A series of case examples will be presented to illustrate how these forces interact.

Before discussing the importance of tenure on NTTP production, the author would like to set forth several non-market oriented hypothesis regarding the forest. These are based on observations in the Indian and wider Asian context:

- The greater the household and community tenure security over forest resources, the more intensive and sustainable their management

- Heavy dependence on natural forests for subsistence goods and environmental concerns can have equal or greater impact on household labour investments in forest management than commercial NTTP production.

-Greater tenure security, less trade restrictions, and more stable market prices are positively associated with more intensive and sustainable NTTP production systems. High NTTP market prices, especially when subject to fluctuation, are positively associated with unsustainable NTTP production systems.

-The rapid growth of an NTTP market will usually lead either to the cultivation of the product on private lands if technically possible, or its over-exploitation in the forest

-The rapid growth of an NTTP market may lead to its capture by local elites and increased inequities in income distribution within a forest community.

-Due to their low opportunity costs, uncommercialized NTTPs disproportionately benefit women, children, and low income groups. Commercialized NTTP disproportionately attract and benefit men and upper income groups, due to their political power.

TENURE CONDITIONS AND FOREST DEVELOPMENT STRATEGIES

Since the time of Adam Smith (1776) and later John Stewart Mills who established the Land Tenure Reform Association (1870), it has been argued that "a landholder's incentive to invest in agriculture and especially in a landholding increases with the exclusivity and security of tenure" (Bruce & Fortman 1988). There has been a growing recognition in recent decades that usufruct and tenure conditions of forest communities also effects their decision making regarding forest use. The historic erosion of rural community rights in India over forest resources parallels their declines in productivity. According to the Society for the Promotion of Wastelands Development in India in 1984, 35.9 million hectares of state forest land and 94 million hectares of non-forest area were degraded, much of it revenue, other public, or communal lands. These lands share a common feature in their lack of effective access controls rooted in clearly defined rights and responsibilities. India's public forest lands, which represent nearly 23 per cent of the nation's land area, have suffered from unsustainable commercial timber exploitation, followed by poorly controlled local use. Forest departments, which have almost complete legal authority over the resources, have little ground level enforcement capacity. Since local communities have little or no use rights, they must illicitly use the NTTP resources where and when possible, and have no incentive to invest in their management or defer utilization for future benefit.

Forest degradation has numerous agents and causes, many of which reinforce the process. In India, human activities, during the degradation of natural forest vegetation frequently involves five primary processes:

- i) removal of woody species at rates exceeding their renewability,
- ii) excessive grazing by livestock of grass and other herbaceous matter,

- iii) increased incidence of fire,
- iv) topsoil loss and soil compaction, and
- v) a decrease in water retention and recharge capacity.

Degradation often occurs gradually as a succession of biotic disturbances slowly depletes vegetation, suppressing natural regeneration, and inducing sheet and gully erosion of topsoils. This type of degradation process may ensure over several decades. In the end, the complex multi-tiered, multi-species forest structure is transformed to a depleted, highly vulnerable and simplified biological system, with little or no vegetative cover save for scattered thorny and non-palatable species.

India's rich forests have gradually been reduced over the centuries. According to Norman (1989) as much as 90 per cent of the subcontinent's forest cover has disappeared. The total area under forest cover in relation to India's total land mass has declined from nearly 17 per cent in 1972, to 14 per cent in 1982, to approximately 11 per cent in 1992 (World Bank, 1989).

During the mid 1970s, concern over rapid forest loss and the declining availability of wood products led government planners to introduce the concept of social forestry (SF) under its fifth Five-Year Plan (1976-1981) (Chandrashekhar *et al* , 1989). The original goals of the social forestry programme were to produce fire-wood, fodder and small timber resources to meet the biomass needs of local communities, while helping relieve pressures on natural forests. The scheme aspired to reclaim wastelands through afforestation programmes which would provide employment opportunities in rural areas and restore ecological balance. The social forestry programmes were infused with added attention and momentum through a large influx of funds from foreign governments and international agencies. Centrally sponsored SF projects in virtually all states were initiated during the early eighties. Even the commercial banks and industries developed programmes to provide assistance to farmers for raising tree plantations for specific purposes. The SF projects included community woodlots, strip plantations and farm forestry, and focused primarily on communal and private lands. The concept implicitly assumed that most natural forests would remain under strict forest department control to meet industrial and commercial needs, while common and private lands would be reforested through social forestry schemes to respond to the fuel and timber needs of rural communities.

While social forestry programmes have resulted in the establishment of billions of trees, mostly exotic, fast growing species, most farmers and participating communities planted them with the expectation that they would be harvested in 6 to 10 years and sold to commercial markets. The enthusiasm of rural people "to plant eucalyptus declined after 1986, as the tree failed to generate the kind of returns farmers were expecting from its sale. Some farmers removed the tree roots and went back to annual crops" (Saxena, 1994).

Consequently, while social forestry subsidized eucalyptus plantations have allowed India to reduce an annual rate of deforestation estimated at 1.3-1.5 million hectares per year from 1980 to 1985, to approximately 50,000 hectares per year it is questionable whether these newly established woodlots will be sustained (Palit, 1993). Since most social forestry projects are designed around short rotation felling, unless carefully controlled, this may re-initiate the degradation process. Many cutover plantations may re-emerge as large areas without tree cover, further subjected to degradation processes through a host of consecutive biotic disturbances.

The conventional plantation approach has led to serious losses of local tree diversity on common and private farm lands. Monoculture plantations with tightly spaced, high density trees suppress natural regeneration and vegetative undergrowth due to shading and competition for soil nutrients and water. In contrast, the undergrowth and multiple story vegetation in mixed cultures and natural forests encourage a range of micro-habitats. In plantations, due to the loss of diverse, multi-tiered floral micro-niches, faunal diversity also declines. Loss of plant diversity additionally deprives local communities of a whole range, and continuous flow of plant products such as food, fodder, oil seeds, leaf manure and raw materials for artisans.

The history of the Indian social forestry programme suggests that the growth of commercial markets for specific forest products can draw attention away from subsistence oriented NTTPs. India's experiences with social forestry also indicates that forest product markets are highly elastic and that future demand levels are difficult to predict. Initially high prices, reflecting shortages, can fall rapidly as producers respond, especially if production is intensified as it shifts to private agricultural lands.

Perhaps the most fundamental flaw in special forestry programmes was their failure to address problems of tenure insecurity of forest users, a prerequisite for the emergence of sustainably productive NTTP systems. The case presented in below clearly illustrates the problem.

Case of Forest Management in South Rajasthan

The Aravalis are India's oldest mountain range. They provide a natural barrier to the expansion of the Great Thar desert into eastern Rajasthan and the fertile Indo-Gangetic plain. Yet, deforestation in this critical environment is perhaps as severe as any place in India. Recent satellite images of the northern Aravalis of Haryana indicate that 80 per cent of the land areas is badly denuded, while only 5 per cent of the region maintains some forest cover, generally in poor to moderate condition (Srivastava & Kaul, 1994). The deterioration of vegetative cover in the Aravalis has resulted in frequent incidence of drought, famine, cloud burst, lowering the water table, shrinkage of natural forest and pasture lands,

and increasing socio-economic stress on the life of the tribals and hill people (Srivastava & Kaul, 1993)

During the 1970's, the Rajasthan Forest Departments, responsible for sustainable management of the Aravalis, leased extensive areas for commercial logging. After the Central government placed restrictions on timber exploitation in the early 1980's, much of the commercial felling was halted. With the assistance of the Central government and foreign donor agencies a series of extensive reforestation schemes were implemented, but these have had little impact in stemming the process of deforestation and ecological degradation. This experience suggests that past and current assumptions and strategies to stabilize the Aravalis need serious review. A case from the forests of southern Rajasthan provides a compelling illustration of the dilemma.

In southern Rajasthan a Divisional Forest Officer (DFO) notes that his forest division covers over 260,000 hectares, much of which is already severely denuded. Logging carried-out until the mid-1980's removed much of the old growth forest in the Division. Tribal, Rajput, and Gujar villagers seeing the logging also began heavily exploiting the forests through over-grazing, fuel-wood cutting, and by setting fires to facilitate mahua flower and honey collection.

Currently, the DFO estimates that at least 140,000 hectares of the forest area in his Division are experiencing serious devegetation and soil erosion through uncontrolled use. Each year these ecosystems lose biomass, biodiversity, and top-soil loss progressively undermining their resilience to re-establish vegetative cover. The DFO, with a small staff of Range and Beat Officers, is unable to protect the vast forest area under his jurisdiction. Instead, much of his staff's time is devoted to planting a few thousand hectares of highly degraded land with donor funds, while over half of forest lands under his administration are rapidly degrading. Despite the innovative technical strategies being utilized in the small project sites, requirements for budgeting, planning, nursery establishment, protection, and monitoring are staff intensive. As a result, donor support is drawing staff attention away from resolving the resource conflicts that are driving forest degradation on much of the forest division's lands. If such capital intensive, technically oriented social forestry strategies continued for another ten years in south Udaipur, while a few thousand hectares might be rehabilitated, the vast majority of divisional forest lands could experience further degradation and lose much of their regenerative capacity, as well as its NTTP generation potential.

NTTPs: LOCAL USE AND GROWING MARKETS

Research on NTTP needs to be sensitive to the forest-related knowledge, attitudes, and beliefs of producing communities. Forest management strategies

and NTTP use appear to be determined by beliefs and values, indigenous knowledge of the forest, and historical human ecological relationships. These use patterns, however, are mediated by the changing local economy and ecology. Clearly, communities with deep ethnobotanical knowledge and long traditions of utilizing plant and animals species for diverse purposes are better able to efficiently and productively manage natural forest ecosystems than recent migrants. Vasava tribal women in eastern Gujarat were able to list 117 plant and animal species and their local uses in a discussion group lasting little over one hour (cite Limbi PRA). In West Bengal, Santhal, Munda and Bhumij tribals utilize 72.4 per cent of the 214 species of plants, birds, reptiles, and mammals identified in their nearby forests (Malhotra *et al.*, 1991).

For villages that are only partially commercialized, cash is used for a narrow range of needed items including cloth, matches, kerosene, cooking oil, tea, sugar, and spices. Money may also be used to pay for services such as transportation, tailoring, blacksmithing, education, and medical assistance. Yet, in many rural Asian communities, a broad range of material needs are still met through subsistence agriculture and forest gathering and hunting. In essence, the forest acts as a supermarket for raw materials to meet most family needs including house construction and repair, manufacturing agricultural tools, fodder, fuel, food stuffs, fibres, gums and resins, medicines, and ritual and ornamentals materials.

Yet, as the natural environment changes under growing pressures and the market economy commercializes, forest use practices change. A recent study of tribal and non-tribal forest villages in West Bengal helps illuminate some of the traditional and emerging factors shaping NTTP use. The study of 12 neighboring communities in forest areas indicated that NTTPs as a percentage of total household income varied from over 36 per cent to less than 3 per cent (Malhotra *et al.*, 1991). Due to varying dietary practices and needs, in some villages gathered forests foods were so important that their value represented 15 per cent of all family income, while in other communities no forest foods were consumed. Where communities have more abundant farmland, livestock holdings may be higher and forest fodder is often a more significant NTTP. By contrast, where communities are land poor, NTTPs which can be used to generate income as raw materials for cottage industries, such as Tendu leaves, fibre grass and bark for rope making, and medicinals are more significant. Women in many poor villages have increasingly come to depend on commercial fuel-wood head-loading to supplement household incomes.

Non-timber tree products (NTTPs) are estimated to generate 70 per cent of all employment in the Indian forestry sector. Commercial NTTPs alone are estimated to generate Rs.3 billion (\$100 million) annually (Shiva 1992). NTTPs provides employment for tens of millions of rural Indians, who would otherwise be forced to migrate in search of jobs as agricultural labourers or marginal urban

job seekers. One study estimated that NTTP collection generates over 2 million person years of work annually and that this could be increased to 4.5 million person employment years (Gupta & Guleria, 1982). In addition, millions of individuals are employed in NTTP processing and marketing. Yet, NTTPs generate some of the lowest wages of rural employment sector. While the minimum wage in most states ranges from Rs.30 to 40 per day (\$1 to \$1.30), most NTTP collectors earn from Rs. 5 to 15 (\$0.25 to \$.50) per day. Low wages reflect the low productivity of the forest arising from poor management, and the depressed prices imposed by state trading monopolies and private buyers.

Fuel-wood is India's largest NTTP in volume and value. Nationally, India's fuel-wood needs are immense, making the nation the world's largest consumer of trees. In 1985, it was estimated that 141 million tons of fuel-wood was consumed representing approximately 200 kgs per capita (Gupta & Ahuja, 1992). When extrapolated to the 1991 population, fire-wood demand increases to 204 million tons, 88 per cent of which is required in rural areas. According to India's 1987 - State of the Forest Report, the recorded production of fire-wood from forests was 19 million tons, with an additional 30 million tons obtained from private land (Anonymous, 1987). The source of the remaining 155 million tons is not clear, but is probably unofficially extracted from forest and common lands, primarily by women head-loaders. Because fuel-wood collection on state forest land is often illegal or subject to many government regulations, women are often harassed in their work and have no legal rights to manage the resource sustainably. At the same time, because the forest department has limited field personnel, it can not effectively control cutting and other forest uses. As a consequence, NTTP collection takes place under open access conditions. Typically, the user who exploits the resource first, benefits most, while those who wait too long may not benefit at all.

Given the current condition of India's forests, sustainable yield levels are considered to be approximately 32 million cubic metres per year, it is evident that the nation may be over exploiting its forest ecosystem by 800 per cent (Schonberger, 1992). Further, projections indicate that fuel-wood demands may double by the year 2020. While some reduction in percapita demand may occur as electrification and fossil fuels become more widely available, India's growing population will likely expand the demand for forest fuel in the foreseeable. The question regarding ways to control the "sustainability gap" takes on growing urgency. While high demands will tend to encourage over-exploitation, moving from open access to controlled management may be the only way to slow this process. Extending to users the rights and responsibilities for productive and sustainable management can provide incentives for intensified stewardship. The case of the Indian beedi industry, the nation's most valuable NTTP, is informative.

A Case Study of the Indian Beedi Industry

It may be argued that strong healthy markets for NTTPs may lead to better income flows to forest communities and more sustainable management of natural forests. The case of the Indian beedi (or cheroot) industry provides some useful insight into the discussion. Beedis are made from a small amount of tobacco wrapped in a forest collected tendu leaf (from the tree *Diospyros melanoxylon*). The poor man's smoke, the Beedi grew in popularity over the past century, replacing the hookah and chillum pipes. By 1990, it was estimated that the industry turnover was reaching approximately \$2 billion annually. Employing an estimated 5 million persons, with a daily production of 1.5 billion beedis, in some central Indian states the industry is the second largest employer after agriculture (Singh *et al.*, 1989).

Yet, despite the immense growth of this industry, the economic benefits have gone little further than pockets of company owners and state revenues coffers. Most collectors and processors of beedis make between Rs 10 and 20 per day (US\$0.30 to \$0.60). In 1989, even the general manager of Ganesh Beedi, who was highest paid employee of the largest beedi corporation which grossed \$50 million per year, was paid less than US \$100 per month. Because of the low wages, beedi collection and processing attracts individuals with low opportunity costs, primarily women, children, and the elderly. While unions and non-government organizations have attempted to organize NTTP labour to improve wage and working conditions, they have met with little success to-date.

Low wage rates are also influenced by parastatal organizations which control beedi leaf markets in many states. After independence, in an attempt to control exploitative behaviour by entrepreneurs, most state governments monopolized the trade in beedi leaves. Establishing such state-run organizations as the LAMPS, TRIFED, or Forest Development Corporation, rigid purchasing systems were implemented and private marketing agents suppressed or eliminated. Tendu collecting communities had no alternatives but to sell to the state agent, even when prices were set low or the officer was corrupt and set even lower rates.

The land generating much of the tendu leaf was reserved and protected state forest. Again, lacking the authority to manipulate and management the forest environment, communities were unable to fertilize, prune, enrich the plants or otherwise intensify production. Since tendu is a pioneering, sun loving species it establishes itself quickly on disturbed and open forest areas. Since communities had no incentive to intensify production on areas already under tendu, volume increases had to come from newly degraded natural forests, encouraging further forest clearance.

Where communities have started to play a role in management, some of these problems have begun to be resolved. In the Harda area of Madhya Pradesh,

many forest protection groups have complained that since the lucrative trade in tendu leaves was taken over by state-run co-operative societies, both yields and total income have fallen. Since the co-operative's budget for pruning labour is limited, most tendu plants are not pruned and consequently can not produce a healthy flush of young leaves, resulting in low productivity and a poor quality harvest. Further, because this task is often performed by outside labourers, tendu plants are often mishandled and damaged. The co-operative societies have also shortened the collection season, leaving many plants unharvested. The DFO has proposed that forest protection committees be given sole collection rights and communities have responded very favourably. He has also recommended that they take responsibility for pruning and culturing the tendu plants in their areas. This allows the community to shift from being paid labourers to becoming share-holding managers, with the authority to develop their own culturing systems, including pruning and harvesting procedures.

Despite the vast capital and labour involvement in the beedi industry, it remains little studied. Yet, existing evidence indicates while the industry provides million of jobs, they provide marginal incomes at a considerable cost to the environment. Establishing policies that will lead to a equitably profitable, environmentally sound industry will require more than pricing policy and market research. From a legal and social institutional standpoint, it will be necessary to assess how collectors might be vested with management responsibilities for tendu forests if production is to be intensified. From an ecological perspective, more studies are required regarding methods and the implications for managing tendu within natural forests or as a monoculture on private farmlands. It is also necessary to determine whether and how state NTTP trading corporations may be reformed or dissolved to forest gate prices for collectors. Such research would be best done in an integrated or at least related manner, rather than in isolation, since many of the issues are interdependent.

COMMUNITY FOREST MANAGEMENT, NATURAL REGENERATION, AND NTTP PRODUCTIVITY

In the past, when forest resources were abundant, the needs of different user groups could often be met without conflict. Today, the growing scarcity of forest products generates severe competition, inter and intra-group conflict, and inexorable pressures on the dwindling resource base. Unable to evolve co-operative strategies based on common objectives for timber and NTTP generation, forest user groups and the forest department (FD) are alienated by fragmented communications and misunderstandings over the competition for scarce resources. These features generate negative attitudes, fostering non-cooperation and antagonism.

Competing objectives among forest users abound. As primary users and

dependents, women frequently come into conflict with the FD. Forest departments face pressures to generate state revenues from timber. Poor tribal women (who collect dry and fallen wood) wish to maximize non-timber product flows, and hence forest species such as long-gestation fruit trees and fast-coppicing multi-purpose species. The FD and Forest Development Corporation fight over different management objectives, including short-term profit motives versus multiple forest products and environmental services. Where sincere, the FD attempts to defend the forest against the local elite and entrepreneur who maximizes profits through illegal logging. Village elites who frequently control the Panchayat and co-opt forestry benefits are at odds with disempowered village minorities who lack recourse to ensure a more equitable distribution of benefits. Negative environmental externalities in the form of soil erosion, sedimentation, downstream flooding, droughts, desertification, and loss of biological diversity threaten all, but impact the poorest, most forest-dependent directly and disproportionately.

Emerging evidence generated through field documentation in India indicates that there is a growing grassroots environmental movement. In the eastern Indian states of West Bengal, Bihar, and Orissa approximately 10,000 villages have begun patrolling an estimated 2 million hectares of now regenerating forests. It has only been in the past five years that the work of millions of villagers to renew badly degraded forests has become recognized by government planners, donors, and scientists.

The circumstances and forces that have facilitated the emergence of local community controls are still only partially understood. Perhaps more importantly, the process through which thousands of communities learned of this new approach to managing critically needed forest resources has yet to be documented. Preliminary case studies indicate that communities, which have historically had a heavy dependence on forest resources, are responding to growing scarcities of critical products. It is interesting to note that intensified management controls have been based, not on a growing commercialization of NTTPs, but rather a combination of growing scarcity of subsistence NTTPs, environmental concerns, and a changing political climate.

This experience leads us to hypothesize that the key to reversing forest "mismanagement" lies in socio-political and institutional changes. In dramatic contrast to the conventional paradigm that economic development, which assumes that market, capital, and technical inputs in poor nation will eventually renew and protect the forest estate, India's experience suggests that socio-political strategies involving community empowerment, attitudinal, and institutional reform are a more essential priority to achieving the stabilization of forests as renewable resources.

A growing body of research indicates that much of India's degraded forest

ecosystems can regenerate rapidly if effectively protected from successive disturbances. Regenerating natural forests can be manipulated to accelerate tree growth, gap and canopy growth, vegetative ground cover, and biomass accumulation. These ecosystems can also be managed to optimize the availability of certain valued timber and NTTPs. Management issues include the types of desired product, seasonal timing of availability, labour requirements, financial investment needs, and other considerations. Communities protecting degraded natural forest are likely to face a number of management issues which have ecological, economic and institutional dimensions in deciding how to intervene in natural forest regeneration and management. Community forest managers will need to consider a range of questions including. how to achieve high productivity of desired tree species and other plant products while ensuring sustainable yields; how to minimize uncontrolled damage due to biotic factors such as grazing and destructive harvesting practices; and how best to conserve soil and moisture for sustained productivity

IMPLICATIONS FOR NTTP RESEARCH AND DEVELOPMENT

Despite the importance of NTTPs to both the national economy and to tribal and forest community livelihoods, enhancing their production and marketing has been given little attention until recently. In fact, the production potential of NTTPs has been estimated at 2.5-10 times current levels (Gupta & Gulenia, 1982). Still, except for a few major NTTPs such as tendu leaves, research into the silvicultural requirements for enhancing productivity and market opportunities has been woefully limited. If guided and technically advised by the government on price information, markets, and infrastructure, the scope for NTTP improvements through value-additions and better marketing is vast. Higher returns from NTTPs cannot only directly increase household incomes, but also can generate employment, improve women's welfare and labour burdens, and ameliorate the environment by taking some of the pressures from over-grazing and fuel-wood head-loading off pastures and forests. In sum, NTTPs play a major, possibly dominant, role in the formal forest sector economy, while employing tens of millions of rural people in the informal sector. Placing a priority on developing management objectives and systems which emphasize NTTP production over timber would seem a logical response to the need to increase rural employment opportunities and stabilize natural forest resources

The careful, sustainable manipulation and management of natural forests can substantially improve the productivity of desired species, absorbing labour while generating greater income in cash and kind according to seasonal demands. Unfortunately, only limited scientific research has been conducted to identify the most effective ways to intensively manage natural forests for a mix of timber and non-timber products. While community-based, ethnobotanical

knowledge is extensive for some ecosystems, it is often unwritten and rarely utilized by outside planners. Further, on state forest lands, communities have neither the tenure security nor the right to manipulate forests for long-term productivity increases. In the future, if the natural forests of India are to be intensively managed to optimize yields of desirable products, a broad based programme of systematic experimentation will need to be initiated jointly by communities and forest departments, with collaboration from universities and non-governmental organizations. Participatory rapid appraisal methods which draw on local knowledge are proving effective in accelerating learning. Further development of field level techniques which allow communities to monitor productivity and ecological changes occurring through various natural forest manipulations require immediate attention.

The market share of some NTTPs, used as raw materials for specialized industries, has shrunk as they have been replaced by synthetic materials or alternatives. Yet, new NTTPs are emerging to fill new market niches. Market monitoring studies are needed which can project the disappearance of old and emergence of new NTTPs. It will also be useful to gain greater insights into the types of species and products which can or cannot make the shift from a natural to an artificial habitat (i.e. from forest to field).

CONCLUSION

By 1989, the Indian forest generated 3.7 per cent of the nation's Gross Domestic Product, with NTTPs representing 57 per cent of forestry's contribution. The GDP, however, is a limited indicator of value. It captures but a small portion of the forest's actual contribution — only those goods which are tangible, marketable, and documented. Such calculations ignore two important factors: the much broader range of qualitative forest benefits and services which elude market valuation, and the proper costing of environmental externalities which result from forest destruction. It has been estimated that the value of ecological and environmental services proffered by the forest as an integral system may be 8-10 times its recorded value of goods (Schonberger, 1992).

NTTPs are some of the most ancient trade products, yet they remain at the periphery of national and international markets. This is due, in part to the fact that they are largely unmanaged. Most are collected in secondary or primary forests, falling under the jurisdiction of state forest departments. Since the nationalization of most of the world's forests over the past century, local user rights have generally eroded. The loss of control over these resources have often reduced user incentives to invest labour and capital in more intensive manipulation of natural forests to increase NTTP productivity. Further, the increasing controls imposed by the state over trade in NTTPs has also diminished collector profits. Minimal forest controls have also led to exploitation of NTTPs reducing

productivity and, in some cases, leading to the extinction of valuable species.

It is argued here that the future of NTTPs will depend on a shift toward more intensive management, accompanied by tenurial rights secured by community users. This process of turning over public lands management to community groups is already ongoing in many countries in Asia. The transition in management requires the establishment of legally sanctioned pairings of communities with forest patches. Typically, communities begin by organizing basic forest protection activities to control grazing, cutting, fires, and other disturbances. Protection facilitates rapid biological regeneration. The implementation of access restrictions to facilitate regrowth represents the first stages of the transition. The second stages respond to production issues.

In conclusion, the author suggests future research into ways to encourage NTTP production which must first ascertain how tenure security for forest users can be enhanced to encourage their investment in the forest resource. Emphasis should not be placed only on developing a limited range of commercial products, but on ways to better manage a diverse range of subsistence NTTPs as well. Effective resource access controls are a prerequisite for the successful management of Asia's forests in the 21st century, and in most cases, only local communities are logistically positioned to insure they are present. Once healthy natural forests are protected through a clarification of rights and responsibilities and effective field level management systems, opportunities for improving technical and market aspects of NTTP production will emerge.

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New Approaches to Changing Trends in NTFP Oriented Management

M.P. Shiva

It is a global concern that the sick biodiversity and the disturbed ecosystems may be rejuvenated. A multi-disciplinary approach is needed to meet this challenge. All those concerned, in this task, have been addressing the issues in different ways to solve the problem, but no clear cut strategy for the development is really available as yet.

The "Centre of Minor Forest Products"—a small non-government organisation—has endeavoured to share the burden of the above national task. The nucleus of the entire exercise is—the appropriate choice of species to be multiplied in adequate proportions within the network of innumerable programmes which are in vogue within the country for conservation of ecosystem, maintenance of biodiversity and socio-economic development. In fact, very well balanced, well thoughtout and concerted efforts are necessary. A co-ordinated approach of all the policy makers and departments is of paramount importance. It is, therefore, necessary that there should be a nodal agency (cell) in the country within the Ministry of Environment and Forests or CSIR (Council of Scientific & Industrial Research), which may link all the activities and a clearance should be obtained by all the working groups to ensure that no duplication of work occurs and the results obtained there from should be fed back to the nodal agency (cell). In this exercise simplicity should be maintained without involving the hierarchy of the existing system and the ministerial hang ups. This can be eliminated because only technical clearance would be required without addressing any financial implications. The purpose of this nodal cell will be only to see that there is no duplication of the research work by different agencies on similar conditions. And after completion of the work, it should be ensured that the different agencies give the feed back of the results obtained for co-ordination and application of research work from laboratory to the field. This will help all the user groups in the country utilizing the data. A well devised data-base should be developed for scrutiny and proper execution of activities. Data-base can be used to identify individual MFP species by different user groups for local and commercial use. This will also help in obtaining relevant information in making decisions and for conservation purposes. A flow chart at

the end highlights linkages for network of Integrated Resource Management plans.

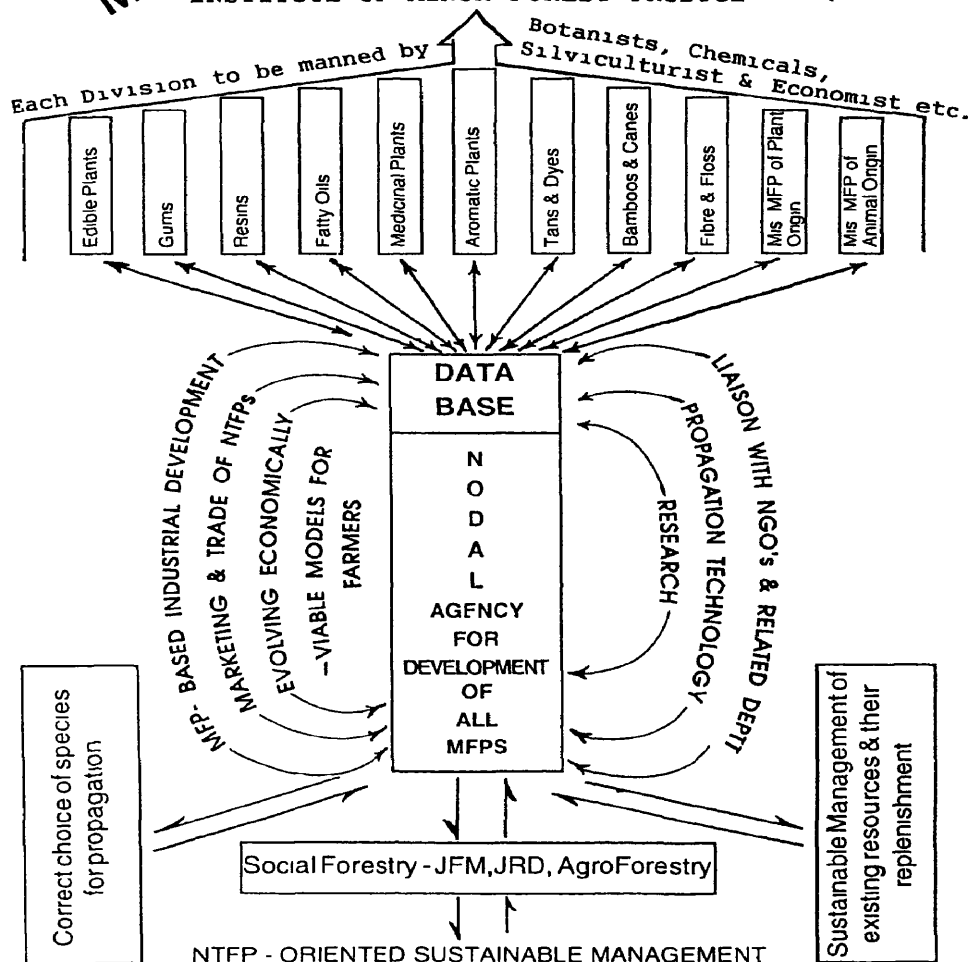
A practically possible National Action Plan with a systematic research and development has to be developed with the consent of experts who are really willing and concerned for the cause and not the mere generalist. The main focus will be to develop a balanced ecosystem, having all its component species of both flora and fauna with known usefulness for the sustenance of life. Through this holistic approach, the earth has to be saved for the healthy living of the future generation. If the things will go, as they have gone in the past and are going on at present, it will put a question mark to the balanced ecosystem of the earth. But it has to be removed by some innovative means. Otherwise, it would mean that the science has cursed the human beings. The solution lies with smaller as well as bigger organisations. An integrated resource management plan with the enthusiastic participation and support of a growing number of foresters, economists, social scientists, public administrators and policy makers, has to be built up for implementation. The programme should be launched with the full participation of local community and endeavours should be made to strengthen the National Forestry Action Programme (NFAP), formulated by Govt of India for development of forestry sector. The centre of MFP has fulfilled the task of assessing NTFP resources for NFAP in 1995.

Ecologically sound systems of forest management are one of the tangible steps that need to be implemented to protect and maintain biodiversity and conserve ecosystem with genetic resource for future utilization and management. In order to meet the challenge in this direction, the Centre of MFP has been endeavouring hard and conducted an International seminar on "MFP in Forestry" in April 1993 and "Management of MFP" in November, 1994.

It may be stressed that of late, Non-Timber Forest Products or the Minor Forest Products have gained importance in Forest Management. There is a great need that forest operations, e.g., timber extraction, saw milling and harvesting of pulp for paper manufacture may be integrated with NTFP enterprises to boost the economic gains. Continued heavy fellings in the forests, whether intended on scientific lines or forced to provide land for non-forest uses, now call for adequate conservation measures. The solution lies in searching new combinations of large and small industries based on harvesting both major and minor forest products that would deter the rate of extraction of major products (timber), yet provide compensatory revenue from MFPs. Thus the forest resources would become more sustainable and the venture would be economically feasible too. This warrants introduction of such management systems which may have optimum felling cycles/rotation with lower harvesting intensities for timber while boosting production of NTFPs from naturally regenerating resources as well as by replenishment (artificial regeneration) of

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the economically useful forest species. A diversified management may be needed to accommodate the modern concepts of multiple use. Conflicts of interest are also likely to arise between non-wood cash crop collectors and subsistence users.

FAO Rome highlights that “management practices will have to take account of these and other potentially conflicting factors in the future research into new techniques of propagation, varietal improvement and other forms of land husbandry that could help bolster development of new forest industries based on non-wood products”

Studies on coppicing techniques may be made for practical application to obtain better yields from NTFP crops as has been done for obtaining high yield of *Eucalyptus citriodora* leaves for perfumery oil. Similarly, studies to standardize harvesting, grading, processing, storing/preserving and marketing of NTFPs may be augmented. More than research, market development needs people with entrepreneurial vision and drive to see and seize the opportunities for new forms of commerce and forest produce as value-added products.

A compromise may be found by applying research to develop new products from forests with their new markets and later on utilizing the revenue of forest based industries to generate better and more secured livelihoods for the forest and neighbouring village dwellers and thereby check the migration of the forest dwellers to urban areas for better quality of life.

Practical Approach to Boost NTFP Resources for the Common Good

R.B. Mathur

INTRODUCTION

Although man arrived on this planet after vegetation and animal life had established themselves on this planet, with their evolutionary systems in action, he has left behind a long history of use or abuse of natural resources. There has been a cycle of 'Love' or 'Hate' relationships so far as forests are concerned

With increase in population and dwindling forest resource, a situation has come when prudent use of the existing natural resources is to be made. While some still adhere to the belief that 'forests have enough for everybody's needs but not for their greed', it looks more objective to say that it has become necessary to augment the vegetational resources so that there remains a satisfactory balance between supply and demand and the protection of the resource vis-a-vis its use for the poor and forest-dependent communities.

THE SOCIAL FORESTRY APPROACH

In the past, social forestry programmes were carried out with the essential above objective. It is seldom realised that there was a time since the fifties, when continued felling were nursing another crisis — that of acute shortage of fuel-wood. No food could be cooked without fuel. So to begin with, the emphasis was on meeting the fuel-wood needs of the people. Large-scale plantations of mainly *Eucalyptus* in plains and tropical pines in the hills were made. When the time came for harvesting the produce, the same old system of 'auction' was employed, thereby undermining the social objective for which the plantations were created. People from afar gave higher bids and the produce went to distant markets, far away from the adjoining villages in whose vicinity the plantations were created. The villagers were deprived of the intended benefits, to which they were looking all along. This fault in the policy with regard to the distribution of the benefits made the scheme unpopular with the people, although there was great potential in it. With subsequent modifications in the choice of species (to contain more fodder, fruit yielding species and other species suitable for forest-based small-scale cottage industries) once the fuel-wood crisis was

resolved it was possible to provide for not only meeting the sustenance needs of the people, but also to provide them more employment possibilities, thus elevating their quality of life in general.

THE JOINT FOREST MANAGEMENT (JFM) APPROACH

It soon became obvious that unless people were associated with the planning and management of the created resources, they will not be impressed or assured of the benefits actually going to them. Since people had resorted to unscientific (and unscrupulous) exploitation of the resource, their involvement was extremely necessary so as to protect the vegetational resource and restore some semblance of scientific harvesting. Forest Protection Committees formed in West Bengal have shown commendable success in this regard.

However, the question arises as to who are 'the people'. Target groups, the landless poor, the artisans dependent on the forest produce can no doubt be cared for. But what about the greedy merchants operating behind the scenes who tacitly infiltrate into the ranks of Target Groups or the Forest Protection Committees (FPC). Besides as number of such committees increase, their number getting larger and larger as more and more villages are covered, it becomes difficult to effectively monitor their activities. Further the work of the FPCs is likely to fall into the trap of endless meetings, recording and coming to unbiased decisions, putting aside nefarious vested interests from socio-political elements who pull reins from outside.

It is true that introduction of need-based Minor Forest Produce (same as Non-Timber Forest Products or Non-Wood Forest Products) dominated management has great potential to help in alleviating poverty among the weaker sections of the society. FAO (1991) studies provide proof that small farmers may profitably be approached to switch over to mixed or multi-layer NTFP plantations as that holds greater promise to boost their economy *vis a vis* the current cropping patterns.

Hence the best combination would be JFM with individuals being motivated to grow quick-yielding non-timber forest species (intercropped with cash crops according to their preference) in their own areas, which would provide them direct benefits annually or within a reasonable time.

CREATION OF DEMONSTRATION FARMS

Motivation is best provided by demonstration plots, for seeing is believing. Hence there is an urgent necessity to set up such plots suitably scattered in the region so that villagers could be taken to such sites (or to which they could conveniently go) to see for themselves the benefits of the advocated measures.

In this regard, vacant areas of absentee landlords could be utilised with their consent.

DEVELOPING INSTITUTIONAL SUPPORT

In all development works mentioned earlier, it is clear that without provision of adequate institutional support, no efforts are likely to succeed, bottlenecks of availability of finance at the right time and marketing will be beyond the capacity or the capability of the small and medium farmers

Nor can such institutions be of material help who do not possess adequate technical expertise with regard to both the agricultural species and the more exacting non-timber forest species suitable for meeting sustenance needs and to provide for setting up small forest-based cottage industries on individual or co-operative level

Forests are the home of a host of species which can be grouped under:

- i) edible plants,
- ii) fatty oil yielding plants,
- iii) aromatic plants,
- iv) medicinal plants,
- v) gums and resin yielding plants,
- vi) tans and dyes yielding plants,
- vii) fibres and flosses bearing plants,
- viii) bamboos and canes, and
- ix) miscellaneous category — bidī leaves, beads, nuts, lac, shellac, tussar, honey, ivory, hides, skins, horns and bones of animal origin.

And the largest amount of information with regard to these is with the forest people or the people living inside the forests (tribal). It is therefore in the fitness of things, that the Forest Department itself takes a leading role in providing impetus to this developmental work. The Forest Department should train a complement of its staff to act as 'Rural Development Officers' and enlarge their area of operation (so far confined to the Reserved Forests) to cover adjoining villages to begin with. A phased programme in this regard needs to be drawn out

SEPARATE EAR-MARKED SET-UP AND A REVOLVING FUND

It will be necessary in this context to make a separate set-up (an additional circle) under the Principal Chief Conservation of Forests with a CCF or CF in-Charge, designated as Chief Conservator (Rural Development), with supporting staff consisting of a research component—a silviculturist, and officers of D C F's rank to act as Rural Development Officers, whose knowledge should

periodically be upgraded by short Refresher courses on marketing, extension and communication.

It is also proposed that a 'Revolving Development Fund' should be created within the Forest Department, from which advances could be given for specific works in rural areas (villages) connected with the development of NTFP resources and to which revenues could be replenished from the income generated or earned through sale or utilisation of the produce (to make the Fund self-sustaining in due course) leaving aside a part to build 'Community Reserve Fund' for future activities. Of course necessary agreements/instruments of negotiations will have to be devised and entertained in this regard. Something should be learnt from the "Chakriya Vikas Yojna" used to develop village resources in the district of Palamau in the state of Bihar. In a different sphere we notice that funds are provided for the construction of bridges, cost of which is recovered through toll taxes and the fund then provides for construction of other bridges. No additional funds are sought through fresh budgetary grants. Each Divisional Forest Officer should be asked to adopt a village. Since sites vary, conditions vary, location-specific solutions have to be found. Development of case-studies will go a long way in developing methodologies and streamline procedures to improve storage, marketing, etc., to assure increased income to the farmers and to provide for generation of employment locally to alleviate their poverty.

GENERAL BENEFITS

At present, there is great exploitation of tribals by middlemen (contractors/traders or their agents). Though primary collection is done by tribals and villagers or forest-dependent communities, they do not get appropriately paid.

There is scarcely full awareness at the local level regarding the ultimate use of the NTFPs extracted, their real market price or possibilities for value-addition.

The proposed course of action will eliminate (or reduce considerably) the handicaps which the poor cultivator or the collector of NTFP presently faces.

If we can lift the poor out of their present predicament and provide them a proper direction, we would have done a signal service to the cause of the poor and add dignity to them and ourselves to make a more purposive vibrant society.

FORESTERS TO ACT AS PATRONS

In the past, Foresters had acted as Patrons/Guardians of the local adjoining populations or those residing within. They had set up and run schools, installed hand pumps and provided petty grants to artisans, skilled village workers who entirely depended upon forest trees/produce. That was strengthened (or was

perhaps obligatory) by the fact that in the remote areas at that time, no civil agency was nearby or easily approachable on the part of the local people

The Foresters had acted as Patrons before, they should again take up that role in the changed set-up (when forest resources are fast depleting) and help in raising the quality of life of the local people by developing their earning capacity and generating more employment opportunities by augmenting tree/vegetational resources both within and outside the forests

RESUME

There is sufficient realisation about the need to do something positive to alleviate the pressure on the forests to meet the basic needs of the surrounding population, but the expanding demands with alarming increase in population and the continued shrinkage of forest resources (often in the name of development) has been a dilemma for the planners. Social Forestry was one approach but because of lacunas and inadequacies in policy with regard to distribution of benefits, it failed to meet its proclaimed objectives.

Joint Forest Management (JFM) is the current approach. User group approach and formation of Forest Protection Committees has also to be saved from falling into the trap of endless meetings and exploitation by influential groups in socio-political spheres.

Perhaps the best combination would be JFM with individuals being motivated to grow quickly yielding non-timber forest species (NTFP) in their own areas. Studies conducted by FAO reveal that small farmers may profitably be approached to switch over to multi-layer NTFP plantation which hold greater promise to boost their economy *vis a vis* the current cropping patterns. Lands of the absentee landlords can better be used for creating demonstration plots where different strategies could be experimented with.

Yet in all these efforts, it is clear that without provision of adequate institutional support, no efforts are likely to succeed; bottlenecks of availability of finance at the right time and marketing will be beyond the capacity of the small and medium farmers

It is proposed that the Forest Department should take a lead in acting as a Nodal Agency in handling the work and step out of the domains of the 'reserved' forests. As sites vary, conditions in each village vary, location-specific solutions have to be found. Hence it is suggested that each Divisional/District Forest Officer should adopt a village and build up case studies for the benefit of future workers. On the other hand, in the forest along the peripheries of the villages, plantation of NTFPs should be done with peoples' involvement under JFM approach.

To cater to this kind of work, a separate Conservator with supporting staff

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(a Silviculturist, a Resource Manager, etc.) should be deputed in each zone, under the Principal CCF to give due impetus to the work.

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Management of Non-Wood Forest Produce (NWFP) and Environmental Economics

Rajendra Dobhal

INTRODUCTION

Recent decade has witnessed rapid economic development at the cost of natural resources. With the advancement of economics and measurement of environmental benefit, there appears a growing concern in many parts of the world about our natural resources (especially NWFP) and renewable environmental resources as economic goods. Adverse impact of economic growth on environmental degradation can be reduced. Sound environmental policies, in which economy run in such a way that the welfare of future generations could be sustained indefinitely, can form the basis for taking up both environmental and developmental problems.

This paper highlights Madhya Pradesh (a Central Indian Province) forests, that support maximum number of tribal life and earn maximum revenue (over Rs. 400 Cr) in India. In fact, agriculture is secondary for tribal population. They derive their livelihood from NWFP. Shrinking of forests and increasing population made the Government to restrict their access to forests. These restrictions and concerns for tribal people of Madhya Pradesh are not new (Elwin 1963).

In M.P., of the total 4.43 lakh sq. km geographical area, 35% is classified as forests. NWFP play an important role in supporting tribal life and revenue earnings. NWFP includes a) Nationalized produce comprising of Tendu (*Diospyros melanoxylon*) leaves, Sal (*Shorea robusta*) seeds, Harra (*Terminalia chebula*) and Gum along with sericulture sector, b) Non-nationalized produce are other than nationalized forest produce. This paper gives emphasis to NWFP potential in Bastar District. This district exceeds the area (total geographical area 39,114 sq. km) of the state of Kerala, with 21,640 sq. km forest cover that represents 3% of national and 13% of states' area under forest. Bastar is also the biggest tribal district of India and its population is about 22.5 lakhs (1991 census). More than 70% of its tribal population depends on the NWFP.

MANAGEMENT OF NWFP

Following are some important R&D-oriented problems for NWFP which need

to be looked into. This would generate tremendous revenue and prosperity among tribal people. The data for annual production/revenue for various NWFP except lac were collected from MPMFP (Trading & Development) Co-operative Federation, Bhopal.

Tendu Leaves

Tendu (*D. melanoxylon*) leaf collection is the most important economic activity for tribals and also a source of revenue. During the years 1991, 92, 93 and 94, total collection/storage of Tendu leaves was 60.66, 45.79, 44.67 and 40.96 lakh standard bags (one standard bag equals to 1000 bundles—each bundle comprising 50 leaves) with net profit earnings of Rs 39.39, 118.07, 84.52 (@ Rs 250/St.Bag) and 30.38 crores (@ Rs 300/St.Bag) in respective years. Total revenue for recent years is not complete as marketing remains on round the year. There appears a need for improvement in a) the size and quality of Tendu leaves, and leaf thinning for cigarette manufacture for exports, b) environment friendly solution of pathological problems (like neem) to protect leaves from gall infestation (Tilak & Rajan 1992). This disease is very harmful and lowers its productivity, and c) the leaf bundles comprising 50 each should be dried in sun (40°–45° C) during May end for about 8 days each side 4 days. A second harvest can be taken during September but drying of leaves is a problem. Leaves are dried on the spot only and electrification in these remote places is not possible. One possibility is solar drier with batteries (FRI and other institutions have developed it, but are not being used). Leaf collection is in bulk and driers are too small and depend on solar energy. The loss of revenue is further enhanced due to the impact of rains during April-May.

Lac

This is a resinous secretion of animal origin (insect called *Laccifer lacca*). This insect mostly thrives on young branches of *Butea monosperma* (Palas), *Zizyphus mauritiana* (Ber) and *Schleicher oleosa* (Kusum). Bihar ranks first in production of Lac (68.5%), while M.P. ranks second (16.6%). In M.P., concentration is in the districts of Bilaspur, Raipur, Surguja and Balaghat (56.0%). Of the total production about 50% of lac/shellac is exported and most of these small sector units work only for 8-10 months due to shortage of raw material. 80% of stick lac is exported every year from its total production in the country. There is a need to pay adequate attention to this export-oriented industry. Also, there is an increased demand of Lac in international market but industrialists are not coming forward to develop this export-oriented industry. The average production of Lac during 1979-80 to 1983-84 was 2,647 tonnes (MP) and 15,985 tonnes (India) (NISIET 1990).

Bamboo

In M.P., despite a great demand for bamboo, local production meets only about 8% of M.P. demand. Forest Department has embarked 25% of 2000 ha/year (afforestation of degraded forests) to bamboo (Tilak & Rajan 1992). To bridge-up this deficit, tissue culture grown saplings may be planted on degraded forests. Modern methods may be used in identifying more markers associated with higher biomass production. Huang and Murashige (1983) noticed distinct glutamate oxaloacetate-transaminase isozymes among four bamboo species. Polyacrylamide gel-electrophoresis of isozymes and leaf proteins could be useful in identifying and indexing superior genotypes (Johnson 1965).

Sal Seeds

Total revenue from Sal seeds was Rs 237.80 lakhs (@ Rs 120/q), 738.32 lakhs (@ Rs 135/q) and 657.63 lakhs (@ Rs 150/q) during 1991, 92 and 93 respectively. While total collection was 198163, 546900 and 438420 tonnes in the respective years. Sal seed oil is now mainly used for detergents. It is also exported by many private companies for manufacture of detergents. It is desirable to discover new, more remunerative uses of Sal seed and oil. Tribals use drastic methods for collection of Sal seeds (Cutting/burning of trees). Use of abscission agents can be tried for this purpose on experimental basis. Development of Sal seed processing unit and better methods of decortication of Sal seeds for improved oil yield need to be worked upon. Use of wings of Sal seed as tanning agent needs to be investigated besides storage and transportation facilities.

Myrobalans

These comprise of deciduous forest species—Harra, Bahera and Amla (*Terminalia chebula*, *T. bellirica* and *Embelica officinalis* respectively). The main use of Harra is in the tanning industry besides being a raw material in the manufacture of textiles and printing ink dyes. About 65% production is reported from MP. UK is the major importer, which reprocess and exports it. The quality we are producing is inferior because of dark colour and the presence of a large amount of iron and copper. There appears scope for promoting units manufacturing myrobalans extract and exploitation of collection potential available for Myrobalans in the state. Harra collection during 1991, 92 and 93 was 157494, 144969 and 140065 qts respectively while total revenue earned was Rs 157.49, 144.97 and 154.07 lakhs for respective years.

Mahua Seeds

Mahua (*Madhuca indica*), seed is a source of oil for tribal people. Oil is

edible as well as used for lighting purpose. The total Mahua flower collection during 1991, 92, and 93 was 9076, 8536, and 3331 qts. (all @ Rs 300/q) respectively and the revenue earned was Rs 27.23, 25.61 and 9.99 lakhs for respective years. Designing and fabrication of rural oil units is necessary

Others

Besides, there is tremendous scope in sericulture, leather, medicinal and aromatic plant sectors in enhancing the revenue from forests in M P. A ban was imposed on the collection of gums on conservation grounds. However, it has been lifted now. Increased yield of Kulu gum by ethephon (Ethrel) treatment can be tried. Chiraunji, (*Buchanania lanzon*), is another important produce. A support-price for raw fruit @ Rs 10/kg was declared for the year 1993-94.

ENVIRONMENTAL ECONOMICS

In the proposed **Global Marshall Plan** of Gore (1992) and other international fora, there has been continuous demand to change the definition of GNP to include environmental costs and benefits and productivity to reflect assessments of environmental improvement or decline (Beaumont *et al.*, 1993). Recent attempts to apply natural resource accounting to developing countries have been made by UNEP, UN Statistical Office (UNSO), The World Bank and the World Resource Institute. These methods differ in both comprehensiveness and objectives (World Development Report, 1992).

In the estimation of National product, according to current methods, forest and other natural resources have no place. In the developing countries (Like India), natural resources *in-situ* are often regarded as 'free'. Environmental Economics can provide a basis for policy makers to take right decisions by applying the principles of cost-benefit analysis of environmental stocks. 'Discovered' by A.C. Pigou in 1920s, his ideas were carried further by James Meade and more recently by Prof. Parth Dasgupta of the Cambridge. The World Institute for Development Economics Research (WIDER) attached to the UN University at Helsinki, is working on the possible link between poverty and environmental degradation (Gregson, 1992).

This subject gets more relevance in the light of new liberalized economic policy. Although GATT was established at a time when the most important concern was economic development, while the 'environment' was not yet on the national agenda. However, since 1970s' environmental awareness in both the North and South has been growing and environmentalists are calling for sustainable development which does not undermine the natural resource base of developing countries or lead to greater pollution and increasing destruction of 'global commons' (Thomas *et al.*, 1994). There have been growing demand for

cost benefit analysis of environmental changes through empirical applications (Johnson 1993), accounting of national resource depletion; and a modified GDP.

Role of R&D

What should be the role of R & D institutions and scientists in the emerging scenario ? In India, expenditure on forestry research amounts to less than 0.01% of the value of forest products consumed every year. More than 60% of Indian exports are natural resource based. This will put greater pressure on rapidly degrading and limited natural resources such as forests in open economy. Total annual budget outlay in the state of MP is about Rs 2800 Cr. and state earns about Rs 450 Cr./yr from NWFP. Funds must be diverted to R & D units for efficient and better management of forest produce as already discussed in some cases.

Empirical Data Collection and DataBase Management

Various attempts are being made by different agencies to create data-bases especially after rectifying Biodiversity treaty. In this era of communication technology these agencies are not networked. Various NGOs/Govt. agencies/Universities are creating databases and even offering consultancy services. It is not worth repeating the work, wasting valuable time and energy. The economic modelling of entire forestry sector is possible only after global/national networking.

Securing Patents to Stop Intellectual Piracy

Patenting of plant derived medicines is necessary by isolating active-principles from different plant species. Tribal people are traditionally rich in curing diseases through herbal medicines/remedies. Bastar region in particular, is a treasure house of useful medicinal plants which grow naturally as undergrowth in forests. We must secure our patents on time before someone is blamed for intellectual piracy. I cite couple of examples of the so called 21st Century Plants found in Bastar region. i) *Nothapodytes nimmoniana*, (Amruta): This is now an export commodity. Higher concentration of Camptothecine (0.10%), and also higher compositionally— a superior concentration (Anti-cancer activity) in P-388 Lymphocytic Leukaemia (mouse) at a dose of 0.5 mg/kg, ii) A herbal product which has been claimed to mop-up Uranium and other long-lived isotopes from nuclear waste. The product originally isolated from the seeds of *Strychnos potatorum*, (Nelmal), can remove Cadmium, Mercury and other toxic heavy metals from factory effluent and can bind to metals such as Gold, Silver,

Cobalt, Copper and Nickel. This was subsequently confirmed by Clement Furlong of the University of Washington (Dobhal 1994). There is tremendous scope for drastic increase in revenue from the forests in MP and Bastar in particular, provided R & D based programmes are given their due share in the light of New Economic Policy.

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Programming the MFP Database

*Pravin Mathur, Tarannum Masood, Harsh Verma and
Amit Kapoor*

In the past, forests have been looked upon primarily as a source of a single product: timber. Forests also provide a wide range of other products such as food, fodder, medicinal products, gums, resins, honey, etc., to name a few. These products are collectively referred to by many different names, viz., **Minor Forest Products (MFPs)**, **Non-timber Forest Products (NTFPs)**, **Non-wood Forest Products (NWFPs)** or **Special Forest Products**. For various reasons like the localised use, knowledge limited with indigenous people, low revenue earnings as compared to timber, etc., they have not been in the mainfold of forestry. It has now become apparent that besides catering to dietary, medical and other pressing needs (fodder & fuel), they can serve as raw material for enterprises based on them, thus providing opportunities for income and employment generation.

THE CONCEPT

Despite the wide prospects of NTFPs, no attempts have been made to systematically document or put on record any facts and figures, collectively available at one place. Information is existent but scattered. With the wide horizon of utilisation, must come the knowledge of their productivity, developmental potential and the necessary basic information required for the development of silvicultural, extraction/utilisation and market management strategies. The continuance of enterprises is also put to question if the entrepreneur is ignorant of the location and extent of availability of the particular species/raw material. The lack of information has been put on record as one of the major obstacles to the development of MFPs.

The idea of a MFP database is the branchchild of Dr M.P. Shiva, the Founder President & Managing Director of the Centre of Minor Forest Products, Dehra Dun. The creation of the MFP database was perhaps the most significant objective of the Ford Foundation sponsored project "**Assessment of NTFP Resources of India for Better Manangement**", which the Centre is currently executing. The objective is to open up for all NTFP users the NTFP related information touching upon various aspects like silviculture, nursery techniques, methods of propagation, etc., in a quick and easy-access format.

THE STRUCTURE AND DESIGN

During the International Seminar on "MFP in Forestry" organised by the Centre

of Minor Forest Products in April 1993, where an assorted group of NTFP users representing foresters, scientists and researchers including ecologists, social scientists, botanists, chemists and representatives of the industry had gathered, the fields or parameters for input of information were discussed at large. These were then circulated to a large number of people for their comments and were also discussed at various fora including the JFM National Support Group Meet at New Delhi in June 1993. The structure was suitably modified to incorporate the suggestions made to widen the applicability and usefulness of the database. The parameters finally drawn up are as below:

LIST OF PARAMETERS

- | | |
|---|---|
| 1. Botanical Name of Species | 24. Demand |
| 2. Family Name | 25. Trade Economics |
| 3. Trade Name/Local Name | 26. Silvicultural Requirements |
| 4. Habit | 27. Phenology |
| 5. Distribution | 28. Methods of Propagation by Seeds |
| 6. Zone Code-Agro-Ecological | 29. Vegetative Methods of Propagation |
| 7. Zone Code-Eco-Floristic | 30. Nursery Techniques |
| 8. Forest Type | 31. Harvesting Technique: (Maturity Time, Time of Harvesting, Periodicity, Stage of Plant Growth, Method of Collection-(Leaf, Bark, Flower/Fruit, Root) |
| 9. Rainfall | |
| 10. Altitude | |
| 11. Temperature | |
| 12. Soil Type | 32. Grading and Processing |
| 13. Uses | 33. Storage |
| 14. Part, Used for | 34. Pests, Diseases (in Field/During Storage/Remedies) |
| 15. Active Ingredients | 35. Economics of Cultivation/Production |
| 16. Value-Added Products | 36. Employment Potential, Present & Future from Cultivation/Harvesting/MFP based Industries |
| 17. Technology Used | 37. Additional Advantages/Utility |
| 18. Yield-per tree and per ha | 38. Important References |
| 19. Potential Production | 39. Resource Persons |
| 20. Actual Production | |
| 21. Cultivation Possibilities & Expected Production | |
| 22. Closest Substitute | |
| 23. Supply | |

There are certain unique information fields outlined in the database. The distribution of a particular species has been presented in 4 different ways to

make it compatible to all whether he is a forester, or an agriculturist or a horticulturist or a layman. The distribution has been put State-wise, while identifying the Forest Type, the Agro-Ecological Regions and the Eco-floristic Zones which overlap a particular State. Facts and figures related to the economic aspects have never been put on record. The entomological data too finds a place. Value-addition and enlisting of the active principles shall prove beneficial in increasing the scope of utilisation as development of technologies takes place.

The MFP database was conceptualised as a complete **Management Information System (MIS)** with a **User-Friendly Operating Environment**. The system displays a **Retrieval Menu** with a basic query system for filtering out the information from the comprehended database. The retrieval menu provides a **query** of identifying species—**Statewise, Use-wise**, as well as those falling within different **Agro-Ecological Region, Eco-Floristic Zone, Forest Type**

As the operator selects an option for querying the database, a **Window** is displayed from which the user can select a particular item by moving the cursor. As the cursor is moved up and down, it *scrolls* through the various item choices. Thus a user can narrow down to the desired information. The operator can thus interactively search for detailed information on a particular species. The database uses codes wherever possible; the *Codes Dictionary* is linked with the database such that information displayed on the screen is *Codeless* and more meaningful to the user or even a layman.

The programme has been developed in *Clipper 5* language, maintaining compatibility with dBASE structures. The programme has been successfully tested with sample data while detailed information collection is underway. Preliminarily about 1280 species have been identified and rated high for inclusion, by a team working under Dr. M.P.Shiva. Out of these about 30 species have been shortlisted for detailed information as regards technologies used, value-addition possibilities, etc. The database was also put up for demonstration and comments during the International Seminar on "Management of MFP" and information shall be made available to all when it is complete, possibly by September 1995.

UTILITY

When complete, the database will provide a gateway to NTFP researchers and users to access information as per his or her requirements. It will also allow him or her to customize an enquiry to suit his or her needs from the wide range of options available.

However, this is the beginning only. In times to come, the database shall be suitably upgraded in content as well as in technology. The database, in future may be put on Networking for International access.

Further additions shall be made to **provide more site specific alternatives**, e.g., by enlisting species for hilly tracts, slopes, wastelands, drylands, mined areas, etc., **identify species that meet user-specified criteria** such as planting site characteristics and desired products and benefits. Multi-lingual glossary to explain technical terms too may be made available.

The information from the database shall provide the managers and users the necessary tools and guidelines to not only manage the resources sustainably but also to indicate which NTFPs have growth potential. The outcome would be greater dissemination of information on opportunities to catch entrepreneurial interest, supported by greater technical and marketing assistance programmes. Then only the goal of **NTFP-oriented sustainable forest management** can be realised in its absolute content.

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Section 2

SILVICULTURE MANAGEMENT

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Silvicultural and Institutional Revision for Sustainable Forest Management

J.B. Lal

INTRODUCTION

Forest management is directed to attain one or a combination of the following three goals: stability of physical environment, productivity, not only of timber but also of Non-timber Forest Products (NTFPs), and equity of social environment. For the management to be sustainable, four aspects have to be taken care of: ecological, technical, socio-economic and institutional. All the four aspects are equally important, and inadequacy of practices in any of the aspects could mar the sustainability of a forest. For over a century, till the beginning of nineteen-seventies, forest management in India has been governed by the doctrine of timber primacy, and silvicultural practices were, by and large, directed towards producing timber of desirable quality in maximum quantity, though some systems, for example Coppice-with-reserve (CWR), were often evolved for sustaining the productivity of NTFPs.

Institutional aspects were not on the agenda till the news of the success of a small experiment started in Arabari in West Bengal, in 1972, reached Delhi in mid-eighties. "State" was the only institution India has known in forest management which has also proved inadequate. To ensure sustainability of forests, silvicultural practices which are ecologically sound, and take care of production of not only wood, but also non-wood products have to be evolved and introduced, and institutional change from "state" to "participation" has to take place.

CHANGING PERSPECTIVE

In forty years from 1955 to 1995, there has been a big change in perspective in Indian forestry. The change is summed up in Table-1.

In those decades, there have been three major shifts in forestry practices, i.e., from sustained yield to sustainability, from timber doctrine to multiple use, and from the state dominance to people's participation.

The shift was inevitable, and all would accept their validity, though some may do it grudgingly. There are, however, three crucial questions in regard to the shift and their answer is to be found, if shift is going to be meaningful. First,

Table-1:

1955	1995
Scarcity of forest products for industrial development	Risk of losing biological diversity
Major forest output is timber	Major forest output is ecosystem services, next to these services are wood and non-wood products of equal importance
View point. nature can be managed or controlled	Impact of human intervention on nature is profound and uncertain, and it could jeopardise the humans themselves
Forestry practices have only local or regional impact	Forestry practices could have global impact
Management sought to secure sustained yield	Forest management seeks sustainability, i.e., to keep forest ecosystems in perpetual good health
Sought good of present generation	Seeks good of future generations also
State control	Participative management
The forester is the expert and decision maker	Public is decision maker, the forester is only technical advisor

what could be the operational definition of sustainability in regard to forest management? Second, what should be the parameters of multiple use? We cannot expect the same package of economic goods and environmental services from every unit of forest. Should the forest be classified on functional basis? Third, what does constitute effective participation? How should the people be represented in management bodies? Representative voices are, more often than not, weak. How should they be recognized?

Sustainability

It is admitted that there cannot be a standard definition of sustainability. It would vary in the context of ecology, economy, and social and cultural environment, or the region. The definition also has to be flexible and innovative. Nevertheless, there has to be some kind of base definition which is less theoretical and more practical.

No country has officially adopted a definition of sustainability in regard to forest use and management. Two definitions, however, appeal themselves, and could be useful in deciding if forestry practices are sustainable.

One was resolved in the Melesenki Conference of European Ministers in 1993. It reads: "use of forests and forest lands in a way that maintains their biodiversity, productivity, regeneration capacity and their ecological, economic and social functions while not causing damage to other ecosystems" (Lal, 1994).

The other is the definition from Canada. Canada's goal is "to maintain and enhance the long term health of our forest ecosystems for the benefit of all living things, both nationally and globally, while providing economic, social and cultural opportunities for the benefits of present and future generations" (Forestry Canada, 1992).

As a matter of fact, sustainability has three elements: ecological, economic and social. The two definitions take care of all the three elements, and so they are good. However, there are three points which are important in regard to sustainability but not explicitly mentioned in either of the definition.

First, the integrity of forest ecosystems cannot be conceived in isolation. In a managed landscape, forests are very open systems. They influence, and in turn are influenced by other bio-productive systems, viz., croplands, grasslands and fisheries. To maintain the integrity of forest ecosystems, it is imperative that their management is integrated with those of the other three systems. Lal (1989) The researches made at International Centre for Integrated Mountain Development, Kathmandu, Nepal unequivocally bring out that the sustainability of production systems is inseparable from the sustainability of resource base, and to ensure the latter an integrated approach in management of various bio-productive systems is called for.

The second of the three points is that the sustainability of social functions of forests depends on good institutional arrangement the arrangements that can ensure equitable distribution of benefits from the resource (Lal, 1994). It is the concern for the institutional dimension of forest management that has forced the governments, forest managers, and/or user communities themselves to evolve, the concept of 'Model Forest' in Canada, Joint Forest Management (JFM) in India, Community Forestry with user Groups (CF/UG) in Nepal, Forest Co-management in Thailand, Community Forestry Programme (CFP) and Integrated Social Forestry Programme (ISFP) in Philippines, and Saemaul Undong in Korea

Third, productivity and regeneration have so far been considered in terms of trees only, especially timber trees. Regeneration has to be considered in terms of all trees species, but also shrubs and herbs, and productivity not only in terms of wood, but non-wood products also.

Stability

Stability has two components: resistance and resilience. Resistance refers to the ability of a system to resist a disturbance. An ecosystem that easily changes has a low resistance. Resilience means ability of a system to recover to its original state after a disturbance. Experience indicates that there is an inverse relationship between resistance and resilience.

There has not been enough experimental research on ecological stability. Nevertheless, the empirical knowledge does suggest that stability, diversity, and productivity are correlated. *Prima-facie*, relationship between diversity and stability is direct, and between productivity and stability inverse (Lal, 1989).

Silvicultural systems affect diversity, and consequently, stability. In traditional forestry which has been primarily concerned with production of timber, stability, diversity, and productivity all have been measured in terms of trees. With new imperatives in forest management, focus being shifted from timber to production of NWFPs, and conservation of biodiversity, the concept of stability of forest ecosystems will gain a firmer ecological basis.

Participation

“Participation” is a fresh social institution that links forests, people and government. The institution is being considered a viable alternative to market and government in rural development. In simple terms, ‘participation’ means participation of local communities in decision-making and management of natural resources such as forest.

Participation does not have much relevance in macro-economic decisions, but in micro-level decisions at grass-root level, it is proving a strong force for sustained development.

The experiences over the last few decades convincingly lead us to believe that without people’s participation legal provisions and police power are ineffective in protection and regeneration of forests. Participation is the institution for protection and development of forests. It should be realised, however, that it is not easy to set up a new institution, much less in a society ridden by inequalities of class and caste as India is. Also, evolution of a participatory institution depends on certain preconditions:

- i) incentives for people to participate,
- ii) objectives for evolving such institutions,
- iii) relationship between participation and developmental activities, and
- iv) relationship between participation and other institutions, such as government and market.

The concept of participatory forest management has been gaining ground as an effective means for regenerating India’s degraded forests. Converting afforestation programme in the country into a massive people’s movement with the involvement of women is one of the basic objectives of India’s National Forest Policy of 1988. In June 1990, the Government of India issued a circular highlighting the need and the procedure to be adopted for the involvement of village communities and voluntary agencies in the protection and development

of degraded forests. In order to ensure community participation the State Governments have been advised to enlist the communication and extension expertise of local non-government organisations to serve as interface between the Forest Departments and the communities. The guidelines lay emphasis on active participation of the people, both in formulation and implementation of micro-level plans for forest conservation and development.

BIODIVERSITY

Biodiversity a term which is a contraction for biological diversity, describes "the number, variety and variability of living organism" (Groombridge, 1992), and commonly defined in terms of genes, species and ecosystems, corresponding to three fundamental biological levels.

Biodiversity is required not only for the development — defining development as the increase in the well being of human society, but also for its very survival. Biodiversity provides direct economic benefits which contribute to survival and development of human beings. The products obtained from biological diversity "range from food to medicines from cordage to clothing, from oils to perfumes, from paints to dyes, and from detergents to disinfectants" (Lal, 1989). Biodiversity provides ecological services which maintain biosphere in a state supportive to human life. The ecological services range from carbon assimilation to oxygen production, from soil genesis to water conservation, from nutrient cycling to hydrologic cycle and from climate amelioration to pollution control. It is obvious that benefits from biodiversity are both tangible and intangible, and while they are easily appreciated, their quantification poses problems.

To integrate biodiversity in development planning, a socio-political-economic process which chooses the best from the various alternatives proposed, the quantification of biodiversity is necessary. And, quantification is possible only if a clear, limited definition of biodiversity is used, and values attached to biodiversity are properly understood. It should, however, be emphatically stated that biodiversity measures should be meaningful, measurable and manageable.

NON-WOOD FOREST PRODUCTS (NWFPs)

The term NWFP is used to describe all goods of biological origin other than wood, and all services other than ecological services derived from forests. The utility of NWFPs ranges from "food to medicines, from cordages to clothing, from oil to perfumes, from paints to dyes, and from detergents to disinfectants." (Lal, 1989). NWFPs as well comprise services such as grazing, and recreation and aesthetic experience.

Associated with tradition uses as they are, knowledge about most of NWFPs is local and empirical. Even the ecology and silviculture of many NWFPs producing species is not known.

NWFPs provide subsistence to many communities living in or near forests, commonly described as forest dwellers. The management decision in regard to NWFPs vis-a-vis timber cannot be taken purely on economic grounds. The management decision on NWFPs has to be an integrated process, involving the disciplines of ecology, economics and ethnology. A management decision based purely on economic or financial analysis would harm the interest of forest dwellers, though in many cases even an economic or financial analysis would lead to a decision of producing a NWFP rather than timber, say for example, tendu leaves, or sal seeds. A rational approach in regard to forest management would be participative rural appraisal (PRA) involving local communities.

It should, however, be emphatically stated that to shed off the timber bias in forestry requires a series of trade-offs between the interests of various stakeholders, viz., industrialists, urban users, environmentalists, ecologists, governments, and local communities, and trade-offs will have to be based not only on economic, but also ecological, technical, social and ethnological criteria.

The other points which are relevant in integrating sustainable production of NWFPs with other objectives of forest management are:

i) NWFPs are multiple, and most often they are obtained not only from the same forest, but also in the same part of the year.

ii) There has been a progressive decrease in production of NWFPs, and also extinction of some NWFPs producing species on account of management neglect, and over-exploitation in the past.

iii) Silvicultural techniques, management practices, and propagation methods in regard to most NWFP producing species in various ecological zones have not yet been researched upon, and standardised.

iv) The indigenous methods of extraction in regard to all NWFPs are not sound. In regard to some NWFPs, for example, *Terminalia arjuna* bark, they are destructive even. This has to be urgently dealt with.

v) There are many species whose use has not been well appreciated, and

vi) There are a few NWFPs which were once the main source of livelihood of some local communities, but which now with the discovery of non-biological substitutes have no market. One good example is lac, which was in very good demand for use in manufacture of gramophone records. Lac has now no market in the Western countries, and this situation has shattered the economy of local communities in the north-eastern Madhya Pradesh. The clock has to be put back in the case of such NWFPs, and use found for them, so that they could again have a market value, and provide livelihood to concerned local communities.

MULTIPLE USE PLANNING OF FOREST RESOURCES

There are some major problems in the multiple use planning of forest resources. The crucial problems are: (1) determining the decision criteria and the weights placed on them, (2) evaluating the decision alternatives with regard to each criterion, and (3) making the criteria and the evaluation decision alternatives commensurable. These problems remain valid when either NWFPs or biodiversity is to be taken into account.

Each management strategy or treatment schedule considered has to be evaluated with respect to NWFPs or biodiversity. In addition, the measure of NWFPs or biodiversity has to be made commensurable with other decision criteria. Further, in production of NWFPs, it is not only a matter of comparing the value of NWFPs with wood and ecological services, but also comparing the value of NWFPs against each other.

Concerning biodiversity, determining the weight placed on criteria is not only matter of comparing the importance of biodiversity with other decision objectives but also comparing the importance of the components of biodiversity with each other. Biological diversity could be considered to having components, among others: species richness, rarity, vulnerability, endemecity, etc.

In multiple use planning of forest resources, problems 1,2, and 3 enumerated above could be solved by using a decision analysis method called the Analytical Hierarchy Process (AHP) (Kangas, 1992). Both quantitative and qualitative decision criteria can be analytically dealt with when AHP is used.

The steps of the method for estimating a biodiversity index, to be used in the evaluation of forest management strategies are as follows:

- i) Components of biodiversity to be dealt with, are chosen, and
- ii) Weights of the components are determined.

SILVICULTURAL SYSTEMS FOR NWFPs

Silvicultural systems for sustainable yield of NWFPs have to be vastly different from those applied for production of timber. Systems for NWFPs will have to be flexible and site-specific as against rigid and uniform systems applied for timber production. Timber production is concerned with trees, and with only one part of tree, i.e., stem. NWFPs may be obtained from herbs and shrubs also, and from any part of plant from roots to leaves. Timber production involves but a few species; NWFPs involve many species.

Silvicultural systems for NWFPs would involve different time horizons than those in systems for timber production. Timber production systems involve decades. NWFP systems may involve months, even weeks.

One of the major components of a silvicultural system is the regeneration method adopted. In timber production the regeneration is obtained either from

seed or from coppice shoots. In production of NWFPs propagative methods other than coppice, such as from root suckers could be adopted with success. Nevertheless, the systems for NWFPs will be more demanding for the reason that in timber production a tree is killed, and it is attempted that a new tree takes its place. NWFP systems may generally not involve killing of a plant. They may rather require nursing of plants, say for example, nursing of a tree after it is tapped for resin or gum.

Two major issues which present themselves in regard to NWFPs are:

- Is it possible to manage a forest for production of wood and non-wood products simultaneously? and
- Could there be silvicultural systems which are ecologically sound, and sustainably produce both wood and non-wood products?

True, there is much less than adequate research to answer these questions, but the empirical knowledge does give affirmative answers to both the questions. Coppice-with-reserve (CWR) system extensively applied in Madhya Pradesh, though not fully but partially meets the needs of NWFPs production. It is a flexible system, aimed at producing a variety of products, though it primarily concerns itself with wood and wood-trees. Nevertheless, the system is a pointer. Systematic research, and participatory rural appraisals could lead to evolution of adequate systems for production of NWFPs.

CONCLUSIONS

It seems that over the decades since middle of the century the pendulum of forest philosophy has swung to other extreme. It was timber for main product, economics for discipline, and state for institution in 1950. It is now non-timber products, ecology, and people. Extremes never pay in the long run.

Wood and NWFPs both could be produced simultaneously from the same unit of a forest. They are not mutually exclusive. Ecologically sound practices could be evolved to produce both wood and NWFPs. Economics is as important as ecology. We could ignore neither. We have to integrate them in our management practices. As institutions, both "state" and "people" are important. Instead of opting for either, we have to integrate the two, and the name of integrated institution is "participation".

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Ecological Aspects of Seed Collection of *Shorea robusta* with Reference to Uttar Pradesh

A.M. Rai

INTRODUCTION

Sal (*Shorea robusta*) is the most important tree species of Uttar Pradesh. The area covered by Sal is 5,35,287 ha. Sal should not be viewed as a species in isolation. It is the key species in some very important ecosystems. Now that international public opinion is committed to preservation of biodiversity, we have to be very careful in the management of the existing Sal forests because these forests are already in a state of decline due to heavy biotic pressure. Our ancient literature testifies to the fact that extensive and lush Sal forests once covered large tracts of northern and central India and was the cradle of our civilization. These forests have now receded to narrow strips adjoining Himalayan foothills and patches in the Vindhyan tract so far as U.P. is concerned. These forests are also in danger of losing their primeval identity due to relentless biotic interference like over-grazing, repeated fires, wrong management practices, illicit felling, intrusion of hordes of unwanted human beings, etc., etc. Till the middle of 1970s, the Sal forests of U.P. were being managed for production of timber only and no other product of Sal was being exploited commercially. At that juncture commercial value of oil extracted from Sal seed was realized and some areas were leased out to highest bidders for collection of Sal seed on an annual basis by inviting tenders. Corbett and Dudhwa national parks were always excluded from collection of Sal seed. Later on, all the sanctuaries like Rajaji (subsequently Rajaji National Park), Kishanpur, Katarniaghat, Suhelwa and Sohagibarwa were also excluded as per directives of Government of India. As of today, the balance areas have been divided in three groups where Sal seed collection is envisaged every fourth year.

PAST DATA OF COLLECTION

The year-wise data of collection of Sal seeds from 1974 to 1991 is given in Table-1. The figures for 1992, 1993 and 1994 are not available. The present policy is to exploit Sal seed in following forest divisions in following years

(a) 1993 – Haldwani, Tarai Western, Tarai Eastern, Ramnagar, East and West Bahraich - 1,32,308 ha

Table-1. Year-wise data of collection and revenue earned from Sal seeds

Year	Quantity Collected in Metric Tonnes
1974	832 725
1975	540 247
1976	5150 000
1977	11503 370
1978	3658 350
1979	14052 720
1980	795 000
1981	5843 268
1982	2372 000
1983	3251 000
1984	3455 370
1985	1562 370
1986	5046 000
1987	Collection figures not available
1988	Nil
1989	8010 480 (Revenue Rs 28,62,600)
1990	Collection figures not available (Revenue Rs 21,45,000)
1991	3000 500

(b)1994 – North Pilibhit, Kalagarh, Shiwalik and West Dehra Dun-1,24,977 ha

(c)1995 – South Pilibhit, South Kheri, North Gorakhpur, South Gorakhpur, South Gonda - 1,20,666 ha.

It has been estimated that the annual availability potential for Sal seed is 212,230 MT for whole of India. As against this the maximum production has been to the tune of 14,000 which has now dwindled to 3,000 MT.

AGENCY OF COLLECTION

For one year, Sal seed collection was entrusted to Tarai Anusuchit Janjati Nigam in certain divisions as measure of tribal welfare. But there was no collection of seed due to administrative lapses. U.P Forest Corporation also backed out of the task of collecting Sal seed due to administrative hassles. So, the task of Sal seed collection is with the highest tenderer amongst the few oil millers in the state. The tenderer, in turn appoints agents, who get the seed collected through local labour. Labour is paid a paltry sum of Rs 0.25 per kg for dewinged seed and Rs 0.50 per kg for decorticated seed.

CHEMICAL COMPOSITION AND UTILISATION OF SAL SEED

An analysis of dried Sal seed meal reveals 5.23% moisture, 6.16% protein,

16.77% ether extr., 4.81% crude fibre, 63.25% N-free extr., 0.18% calcium, 3.78% total ash, and 0.95% acid insoluble ash. Seeds yield 19.20% of fatty oil (Sal butter) which is contained in the cotyledons. The composition of oil is palmitic 8.3%, stearic 34.7%, archidic 12.123%, oleic 41.9% and linoleic 2.8%. Its use as a substitute for cocoa butter in manufacture of chocolate has superseded other uses in manufacture of soap and adulteration of *ghee*. Sal seed cake can be used as fertilizer, cattle and poultry feed.

WHAT THE PROTAGONISTS OF COLLECTION SAY ?

- (a) Sal seed is a natural resource and should be profitably utilized.
- (b) Only 10 to 20% of annual production of Sal seed is collected by oil industry — that too in the fringes of forests — which does not adversely affect the ecological status.
- (c) As per the reports of IVRI, Izzatnagar, Sal seed is not a very good meal for animals.
- (d) Poor tribals get employment.

WHAT THE ANTAGONISTS SAY ?

- (a) In the process of collection, the forest floor is swept clean and burnt, so that clean seed can be easily hauled. Thus, in the general area of collection, the forest floor becomes devoid of all undergrowth and the micro-flora and micro-fauna also is destroyed. The soil becomes compact. All this is not at all desirable for maintaining the ecosystem.
- (b) The contention that seed is collected on the fringes of forest is not correct. On the fringes, there is lot of lopping and adverse effect of different sources of pollution like fumes from exhaust of vehicles, brick kilns and such industries, noise, dust, etc. All these factors are not conducive for profuse seeding. Naturally, the labour turns its attention to those areas where maximum collection can be made with minimum effort.
- (c) For reasons stated in (a) above, the natural regeneration is adversely affected for future years also, even when there is no seed collection.
- (d) Habitat destruction is the single most important reason for decline of wild-life. For reasons stated above, Sal seed collection does result in habitat degradation.
- (e) The local labour gets a pittance in terms of wages. The cream is cornered by oil mills and middlemen.
- (f) Revenue accruing to government is insignificant compared to the astronomical sums being invested for ecosystem restoration.
- (g) The conclusions drawn by IVRI, Izzatnagar regarding the food value of Sal seed for animals does not appeal to reason. Wild animals have a highly

developed instinct regarding their food habits. Food not compatible to their system is not ingested except in case of starvation. In forest conditions, the observation is that herbivores relish Sal seed. Moreover, it is not a question of Sal seed alone so far as food for wildlife is concerned. Due to sweeping and burning of forest floor, the herbaceous growth is lost—sometimes for ever—which constitutes an important segment of food for wildlife. Many insects, microflora and microfauna are destroyed due to burning and trampling. Thus the whole food chain is disturbed.

(h) Nature has devised ways and means like profuse seeding and intermittent good or bad seed years for species with refractory regeneration. Sal is one such species. If monsoon is delayed or erratic, most of the seeds are lost due to inadequate moisture. So, good management practices dictate that as much seed is retained in the forest floor in a widely dispersed manner as possible. Even if the seed is not turned in a viable seedling, the soil gets enriched by decaying matter.

CONCLUSION

After carefully weighing the pros and cons, the inevitable conclusion is that Sal seed should not be collected commercially in view of the fact that international community is committed to the cause of conserving biodiversity. Sal forests are part of our cultural and religious heritage and all efforts should be directed towards preserving the remaining tracts. Even the policy directive for rotational collection stipulates that progress of natural regeneration should be watched. No efforts have been made in this direction. Surely, the industry can also afford to forgo the meager collection of 3,000 MT from U P in the wider interest of humanity.

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Effect of Thinning on Growth Performance in *Acacia auriculiformis* Monoculture Plantations

A.B. Nadaf, P.K. Kulkarni and L.J. Bhosale

INTRODUCTION

About 40 species of *Acacia* occur in India and a few more have been introduced from Australia and Africa. Some *Acacias* have proved very successful in afforestation in arid regions, due to their rapid rate of growth (Vimal and Tyagi, 1988). Among the species found in India, *Acacia auriculiformis*, a native of Northern Australia and Queensland, is widely planted in India as an exotic (Prakash and Hocking, 1985). It is a very fast growing and evergreen tree. Its outstanding quality is its ability to grow on poor soils, where very few species can survive (Hocking, 1993). Its greatest potential seems to be its use as domestic fuel-wood and industrially for making paper pulp (cf. Hocking, 1993).

A basic stipulation for the highest sustained yield is a prerequisite for such species. So it is important to know the proper methodology to obtain yields of highest volume and value-production within shortest possible time by adopting suitable spacing in the plantation. The objectives of extensive cultivation and spacing experiments established in Germany, in the sixties and seventies of last century, were mainly to discover which types of formation and planting distance would be the most economical under given conditions, i.e., how to secure the highest cash returns with minimum establishment costs. It is probable in the dense plantations that competition sets in between the root systems of adjacent plants before the branches meet, particularly between those of the same species with similar requirements. The onset and intensity of this competition must be judged from the appearance of the crowns. The space available for growth besides light intensity plays a vital role in said competition.

The present investigation is aimed at to determine the effects of thinning operations on the two year-old monoculture density plantation of *Acacia auriculiformis*.

STUDY SITE

Biomass Research Centre at Shivaji University Campus lies in the South-Western region of India. It is situated between 16° 42' 55"N latitude and 74° 14' E longitude, having an altitude of 650 m above mean sea level. The

average annual rainfall is between 1800-1900 mm. The soil type is red.

MATERIALS AND METHODS

Pre-plantation soil working was done in the month of February, 1991 by deep ploughing of the soil. The pits, at a distance of 1×1 m, were prepared having size $30 \times 30 \times 30$ cm. In the month of July, 1991, nursery grown seedlings of *Acacia auriculiformis*, obtained from Social Forestry Department, were planted in the pits along with balls of earth. During plantation, small amount of cow-dung manure was mixed with soil (1.4) and put into the pits

At the end of second year, the block was divided into 4 sub-blocks with 390 plants each. The day before cutting, the growth performance with respect to height and girth was measured as per the method of Assmann (1970). Among the four sub-blocks, the first was maintained as control having original spacing of 1×1 m. Thinning was done to achieve 1×2 m, 1×3 m and 2×2 m spacing. The pollard height was 25 cm. After one year of thinning, the growth performance of each plant was assessed with respect to height and girth in each sub-block. The total fresh biomass of cut plants per sub-block was measured using a spring balance

RESULTS AND DISCUSSION

The results of the present investigation are presented in Table-1. It is evident from the Table-1 that the fold increase in height over initial, after one year, is 1.31 and for girth 1.29. In 1×3 m sub-block, the average height reached to 3.05 m and girth to 10.38 cm after one year thinning. The fold increase over initial is 1.38 for height and 1.49 for girth. In the 2×2 m sub-block, the average height is 2.90 m and girth is 9.85 cm. The fold increase over initial is 1.41 and 1.50 for height and girth, respectively.

Table-1 Effect of Thinning on the Growth Performance of Three Year Old Plantation of *A. auriculiformis*

Spacing after thinning (m)	<u>Just before thinning</u>		<u>One year after thinning</u>		<u>Fold increase over initial</u>	
	Av Height (m)	Av Girth (cm)	Av Height (m)	Av Girth (cm)	Height	Girth
Control						
1 x 1	2.24	7.02	2.95	8.80	1.32	1.25
1 x 2	2.23	7.39	2.93	9.45	1.31	1.29
1 x 3	2.21	6.98	3.05	10.38	1.38	1.49
2 x 2	2.06	6.58	2.90	9.85	1.41	1.50

Most plantations are having even spacing which is ample for the species planted, for atleast the few initial years. The process of thinning increases spacing and thereby affects the growth. In the present investigation the thinning was carried out at an early stage

Assmann (1970) has reported that early thinning can induce favourable effects on increment by accelerating growth. The effect of different thinning methods on the increment, and thereby on the yield, can be correctly judged only if significant differences in growth performance can be obtained. Presently, thinning is achieved by taking oblique cuts (Champion, 1987). From Table-1 it is also evident that the growth performance with respect to height and girth is more in 1×3 m and 2×2 m spacing blocks. According to Trevor (1987), the light demander' species, viz, Teak, Chir pine are less tolerant to crowding and thinning is more important in such species. As reported by Hocking (1993), *Acacia auriculiformis* is a strong light demanding species. Hence, increase in growth is expected with increase in the amount of light made available. Guttenberg (1975) showed that the range of diameter increment in the stem of an older spruce altered after heavy thinning. Thus, the increment in height and girth with respect to spacing can be explained. The typical 'square thinning' pattern formed in 2×2 m spacing also provides the plants with enough space to grow well in height and girth.

The early thinning practised is expected to give early boost to the tree growth. It is to be noted that the thinning in the present case does not involve complete removal of the plant. Therefore, the major response is to light intensity. It is intended to obtain biomass on rotation basis from the same block by allowing coppicing. The biomass obtained at the time of thinning is 514 kg from felled plants, which comes out to be 0.724 kg per plant. By enhancing the growth of the individuals in different spacings, biomass yield would be enhanced. Further, the coppiced stumps will come in rotation to yield biomass. Thus, this study indicates the effects of thinning on rate of growth.

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Section 3

REGENERATION TECHNIQUES

Vegetative Propagation for Improvement of Trees Yielding Minor Forest Products

N.J. Zende, A.D. Karve and A.V. Gogte

INTRODUCTION

Many forest trees yield economically important products other than timber. Such products are called minor forest products. In the course of general deforestation, these trees are also getting gradually decimated, but no serious thought is given to establishing plantations of such trees. One of the reasons for the absence of plantations of trees yielding minor forest products could be the lack of standard varieties and lack of reliable planting material. Because of the relatively long interval between two successive generations, it would not be advisable to start a breeding programme for trees of this category, but one can take advantage of the natural variability available in these species and select individuals showing superior characters. If the selected trees are vegetatively propagated, the progeny inherits all the genetic characters of the parent.

In the course of a project sponsored by the Department of Science and Technology, New Delhi, this Centre standardized a low cost method of vegetative multiplication, that was found useful in a large number of tree species. The present paper describes this method and presents the results obtained in the case of some tree species subjected to this methodology.

METHODOLOGY

Softwood cutting (i.e. stem cuttings with green bark) are cut into segments about 10 cm long, having at least two nodes. Leaves at the lower nodes are cut off, while the laminae of leaves at the uppermost node are trimmed off to about 30% of the original area. The basal part of the cutting is dipped for 10 seconds into a solution containing 4000 ppm Indol Butyric Acid (IBA). After the IBA treatment, the cuttings are planted in a sand bed, watered to field capacity. The sand bed, laid on a plastic ground sheet, is about 10 cm thick and it is held in place by a low parapet of unmortared bricks or stone. The entire sand bed, along with the twigs, is covered by a transparent plastic canopy, held in place by arches of 4 mm thick galvanized wire. The plastic sheet is firmly secured to the ground on all sides by weighing it down by a layer of soil, where it touches the ground. The plastic canopy should always be shaded. If it is exposed to direct sunlight, it

gets overheated, leading to death of the twigs contained in it. Due to water evaporating from the sand bed, the air inside the canopy gets saturated with moisture. Twigs kept in this atmosphere remain fresh even upto 120 days. Most species show good root development under this treatment. In some, it was necessary to make superficial longitudinal cuts on the basal part to facilitate penetration of IBA to the cambial layer. Flushing the sand bed with water, a couple of times every day, also promoted root development in many cases. Depending on the species, rooting took place within 3 to 12 weeks.

After successful rooting, the cuttings are transferred from the sand bed to plastic bags filled with a mixture of soil, sand and compost (3:1:1 by volume) and the bags are again kept under the plastic canopy to allow adaptation of the roots to the new medium. 8 days after transplanting, the cuttings are hardened by exposing them gradually to successively drier air. This is achieved by creating an opening in the plastic canopy, which is widened every day in such a way that the canopy is removed altogether at the end of about 8 days. The cuttings are now ready for being planted in the field.

RESULTS AND DISCUSSION

A total of 17 species of trees was included in this experiment. The species, along with their economically important product, their percentage of successful rooting, and some morphological data about the roots and lateral shoots produced in the course of the treatment, are presented in Table-1. Cuttings of *Bassia latifolia*, *Garcinia indica*, *Semecarpus anacardium*, *Terminalia bellirica* and *Terminalia chebula* failed to produce roots. Attempts were made in the case of some of these to graft young shoots on seedlings of the same species. These attempts succeeded in *Bassia latifolia* (40% survival), *Garcinia indica* (50% survival) and *Terminalia chebula* (30% survival).

All the parameters, i.e., success of rooting, number of roots developed, root length, number of shoots developed, shoot length and days taken in root development, varied widely from species to species, but the results show that the method standardised at this Centre works in the case of about 70% of the tree species tested under this project. The standard nursery practice involves the use of a mist chamber, in which the cuttings are intermittently sprayed with water to protect them from desiccation. In the experiments reported here, use has been made of a low cost device (i.e. a transparent plastic canopy) which does not need any motor power. This innovation allows our method to be used even in remote areas, not provided with electricity.

Because of extremely good results obtained in the case of *Carissa congesta* (90% success of rooting), a separate project, aimed at domesticating this species, was launched last year, also under sponsorship of the Department of Science and Technology, New Delhi.

Table-1: Rooting performance of softwood cuttings of tree species yielding minor forest products (Cuttings were treated with 4000 ppm IBA and kept in a low cost, humidity chamber)

	Species (Product)	Success %	Roots per cutting	Longest root (cm)	Shoots per cutting	Longest shoot (cm)	Days taken in rooting
1	<i>Acacia concinna</i> (saponin)	40	8.2	9.0	2.7	7.7	60
2	<i>Anogeisus latifolia</i> (gum)	10	1.0	1.0	3.0	2.1	75
3	<i>Bavaria latifolia</i> (edible flowers and fruits)	0	-	-	-	-	-
4	<i>Bauhinia racemosa</i> (edible flower buds, beedi leaves)	38	3.4	13.9	3.2	10.0	60
5	<i>Buchanania lanzan</i> (edible seed)	8	3.6	7.2	1.3	2.7	60
6	<i>Calophyllum inophyllum</i> (non-edible oil)	30	2.3	5.1	1.0	1.5	75
7	<i>Carissa congesta</i> (edible berry)	90	12.9	6.6	1.2	3.6	40
8	<i>Commiphora wightii</i> (C. mukul) (ayurvedic medicine)	46	5.2	2.5	1.6	2.8	45
9	<i>Derris indicus</i> (non-edible oil)	85	3.7	9.8	1.8	2.6	42
10	<i>Garcinia indica</i> (edible fruit, non-edible oil)	0	-	-	-	-	-
11	<i>Manilkara hexandra</i> (edible fruit)	100	6.8	4.0	1.4	2.9	40
12	<i>Nonhaphodytes nummularia</i> (Mappia foetida) (anticancer alkaloid)	5	5.3	2.1	1.0	2.0	52
13	<i>Sapindus laurifolius</i> (saponin)	30	1.3	6.6	1.0	4.5	60
14	<i>Senecarpus anacardium</i> (ayurvedic medicine)	0	-	-	-	-	-
15	<i>Syzygium jambos</i> (edible fruit)	17	2.9	1.3	1.1	1.2	62
16	<i>Terminalia bellirica</i> (ayurvedic medicine)	0	-	-	-	-	-
17	<i>Terminalia chebula</i> (tanins)	0	-	-	-	-	-

The high humidity chamber described in this paper, was also found useful in increasing the percentage of success of grafts.

Classes are being conducted to teach this methodology to farmers, nursery-men and also to staff of the Department of Forests, Maharashtra

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Innovative Simple Techniques for Regeneration of Vegetatively Propagated Plants

H.C. Srivastava

INTRODUCTION

Cuttings of most of the plants are rooted in mist chamber. Sometimes electrical breakdown is frequent which poses problem in management of propagation work in such mist chambers. Moreover installation of mist chamber is a costly affair and beyond the reach of ordinary persons to bear cost of installation. In an effort to solve this situation, certain simple techniques have been innovated at Indian Institute of Horticultural Research, Bangalore, for clonal propagation of elite breeding material of Jasmine. Later experimental trials also revealed that the same technique is applicable, for successful propagation of several aromatic and medicinal plants such as night queen, roses, hibiscus, thuja, pomegranate, tabernaemontana, etc. Brief descriptions of the techniques are given below.

MATERIAL AND METHODS

Polythene sachet (size about 40 × 15 cm, thickness 250 gauge) are taken. They were filled upto 10 cm with a mixture of equal proportion of soil, sand and compost and above this with 5 cm of sand only. A little water is added to moist the content. Shoot tip cuttings of the desired plant are taken and treated with the rooting hormone (4000 ppm Indole Butyric Acid for *Jasminum grandiflorum*). Commercially available rooting powder, seradix, is also an alternative. The treated cuttings were planted inside the sachet. Opening of the sachet is folded 2 times and pinned before placing them under tree shade. Shade from hessian cloth (single layer) has been found most suitable for Jasmine. Thin polythene sheets can be also used for shading. These are impermeable to moisture but permeable to gases (Lipp, 1953).

OBSERVATIONS AND RESULTS

The technique outlined above provides sufficient moisture, nutrition and air inside leading to profuse rooting in 30 to 45 days. After this the sachets are opened and 6 to 8 holes are made near the base of each sachet. The rooted cuttings are allowed to acclimatize and watering is done as per requirement. After

10 to 15 days of acclimatization, the sapling can be planted in field. The technique is simple, low cost and requires negligible amount of water. If done properly, 90 to 95 per cent terminal cuttings root very well. The technique has been designated as closed media sachet (CMS) technique (Srivastava, 1988, 1989). This technology is especially suitable where mist chambers are not available and availability of water is also too little. Comparative performance of Closed Media Sachet Technique and Intermittent Mist Chamber Technique is presented in the Table-1.

Table-1. Rooting of *Jasminum grandiflorum* Linn var Pink Pin cutting with Close Media Sachet and Intermittent Mist techniques

Rooting Media	Per cent rooted cuttings	Mean of roots per cuttings	Mean of days taken to root	Mean of days taken for cutting to grow into 50 cm high plant
Stem cuttings struck in rooting media under intermittent mist	67.6	9.38	37.2	237.6
Terminal cuttings struck in rooting media under intermittent mist	79.2	11.50	35.2	237.0
Stem cuttings struck in rooting media in close Media sachet	74.4	12.32	36.4	234.7
Terminal cuttings struck in rooting media in close Media Sachet	81.6	15.64	33.4	236.7
F test	++	++	N S	N S
C D at 5 per cent	7.96	1.32	-	-
C D at 1 per cent	11.16	1.86	-	-

++ indicates significant at 1 per cent

Beside this, another simple technique has been designed where growth media is not all involved. Hence, it has been called Medialess Sachet Technique. The technique is based on utilization of moisture released from transpiration and utilization of stored food. Semi-hard wood cuttings are made to root and sprout in the air, enclosed in polythene sachet without any watering for about a month.

Possibilities are being explored to utilize leaf for regeneration in case of Jasmine. Rooting has been obtained from leaf petiole. Work is in progress.

These simple techniques for regeneration are expected to be of immense practical utility for economic multiplication of selected material of vegetatively propagated plants.

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Application of Mycorrhiza in Forestry

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INTRODUCTION

The intense exploitation of natural forests in the sub-humid to arid tropics is leading to degradation of stable ecosystems. The resulting changes in abiotic and biotic soil properties hamper the re-establishment of vegetation (Miller 1987). The effects of mycorrhizal fungi on tree seedling establishment and growth in such environments should not be overlooked. Plants introduced on to disturbed arid lands face a variety of adverse conditions such as drought, low soil fertility, high temperature—stresses whose impact on plant growth have been shown to be ameliorated in part by mycorrhizal associations (Jasper *et al.*, 1991). Mycorrhizal inocula offer viable biological alternatives to these costly inputs like fertilizers. The term mycorrhiza describes a range of symbiotic structures formed between fine roots and different fungi. It is now well known that in a natural ecosystem most plants will have a well-developed mycorrhizal association. Several morphologically distinct types of mycorrhizae associated with particular soil from vegetation systems have been described. Different types of mycorrhizae are structurally unique and are formed by various taxonomic groups of fungi. Two main types of mycorrhiza include ectomycorrhiza and vesicular-arbuscular mycorrhiza (VAM). Mycorrhizal fungi derive most of their organic nutrition from their symbiotic niche in the primary cortical tissues of roots. The mycorrhizal habit probably evolved as a survival mechanism for both partners in the association, allowing each to survive in environments of low soil fertility, drought, disease and temperature extremes, where alone they could not.

ECTOMYCORRHIZA

In boreal forest ecosystems, the most important mycorrhizal type is the ectomycorrhiza. It is formed by trees belonging to the Pinaceae, Betulaceae, Fagaceae as well as of many other plant groups. The fungi involved in this symbiosis are most commonly basidiomycetes such as *Suillus*, *Pisolithus*, *Boletus*, *Russula*, *Lactarius*, but some ascomycetes also form ectomycorrhizae. In this symbiosis the fungus grows into the root of the host plant and the hyphae penetrate in between the outer cortical cells, forming a typical network like structure called

the Hartig's net; but there is no fungal penetration of host cells. After colonisation the root tip stops elongating but branching may occur. On the root surface the fungus forms a mantle or sheath, which is also a structure typical of ectomycorrhizae. The thickness and structure of this mantle vary according to the species involved in the symbiosis, and the mantle is typically connected to hyphae or hyphal aggregate which penetrate the surrounding soil and often form an extensive mycelial phase. In this way the mycorrhizal root acquires access to a much greater soil volume than non-mycorrhizal root and the effective surface area for nutrient absorption is greatly increased. Ectomycorrhizal forests characteristically show a relatively low diversity of host species but a greater diversity of fungal associates than do VA mycorrhizal ecosystems. A further feature of ecosystems in the boreal and temperate zones dominated by ectomycorrhizal species is that they are normally nitrogen rather than phosphorus limited.

Practical Significance of Ectomycorrhizae in Forestry

The biological requirement of many species of forest trees for ectomycorrhizal associations was initially observed when attempts to establish plantations of exotic pines routinely failed until the necessary symbiotic fungi were introduced (Madu, 1967). The need of pine and oak seedlings for ectomycorrhizae has also been convincingly demonstrated in the afforestation of former treeless areas, such as the grasslands of Russia and the Great Plains of the USA (Goss, 1960; Shemakhanova, 1962). The primary purpose for inoculating with these specialized fungi in forestry is to provide seedlings with adequate ectomycorrhizae for survival after planting in man-made forests. Such treatment has proven essential in forestation of cutover lands and other treeless areas; introduction of exotic tree species, and reclamation of adverse sites such as mining spoils (Marx 1980, Marx and Cordell 1990). Use of ectomycorrhizal fungi can be of major significance to artificial regeneration of forests.

Most investigations on inoculation with ectomycorrhizal fungi is based on two working principles. First, any ectomycorrhizae on roots of tree seedlings are far better than no ectomycorrhizae at all. Success in correcting ectomycorrhizal deficiencies has contributed greatly to our understanding of the importance of ectomycorrhizae to trees, especially as they relate to the establishment of exotic forests. Secondly, some species of ectomycorrhizal fungi have proved to be more beneficial to trees, under certain environmental conditions, than others.

Most ectomycorrhizae have extensive multi-branching habits, and hyphae from them extend considerable distances out into the soil. The extramatrical hyphae function as additional nutrient and water-absorbing entities and increase the ability of the tree to capture nutrients and water from the soil. The fungus mantle of ectomycorrhizae are able to absorb and accumulate nitrogen,

phosphorus, potassium and calcium more rapidly and for longer periods of time than are non-mycorrhizal roots. Ectomycorrhizae also appear to increase the tree's tolerance to drought, high soil temperatures, organic and inorganic soil toxins, and extremes of soil acidity caused by high levels of sulphur, manganese or aluminium. Ectomycorrhizae deter infection of feeder roots by some root pathogens, including species of *Pythium* and *Phytophthora* (Marx and Krupa 1978). Hormone relationships induced by fungal symbionts cause ectomycorrhizal roots to be physiologically active for longer periods than non-mycorrhizal roots (Ek *et al* , 1983).

Many factors affect ectomycorrhizal development and they must be considered in a practical application programme. The first prerequisite to ectomycorrhizal development is that the host plant produce a susceptible feeder root. Second, viable inoculum of an ectomycorrhizal fungus must be present in the immediate feeder root zone or rhizoplane. Third, chemical, physical and biological soil conditions must favour successful symbiotic colonization.

Production of Inoculum

The first and most important step in any inoculation programme for tree seedlings is, the selection of fungi (Trappe, 1977). The selected fungus should exhibit the physiological capacity to form abundant ectomycorrhizae on seedlings of the derived hosts and on the largest possible number of hosts. The fungus must also have the ability to grow rapidly in pure culture and to withstand physical, chemical and biological manipulation (Marx *et al* , 1984). A very important criterion is the ecological adaptation of the selected fungus to the type of site on which most of the seedlings are to be planted. The most widely used natural inoculum, especially in developing countries, is soil or humus collected from established pine plantations (Marx, 1980). The major disadvantage of soil inoculum is that species composition of ectomycorrhizal fungi in the inoculum is not controlled, and the inoculum may contain harmful microorganisms. Spores of various fungi have been used as inoculum to form specific ectomycorrhizae on tree seedlings. Unlike vegetative inoculum, spores require no extended culture under aseptic conditions, and they usually maintain viability in storage from one season to the next. However, spore inoculum has several disadvantages. Spores of many ectomycorrhizal fungi have not been germinated in the laboratory to determine their viability. Basidiospores usually take 3 to 4 weeks longer to form ectomycorrhizae than does vegetative inoculum of the same fungus (Marx and Cordell, 1990). Mycelial or vegetative inoculum of ectomycorrhizal fungi has often been recommended as the most biologically sound material for inoculation. There is sufficient information that pure cultures of certain fungi, such as *Pisolithus tinctorius*, can be used to improve survival

and growth of tree seedlings on a variety of sites. This fungus is used in practical reforestation and reclamation programmes in the United States. Scientists in the USA, France, Canada and the Philippines are the leaders in research development and application of specific ectomycorrhizal fungi. More than 30 nursery tests with loblolly pine in the Southern US showed that abundant *P. tinctorius* ectomycorrhizae reduced seedling losses by over 25% and increased fresh weights of seedlings by over 20%. Additional research on the practical use of specific ectomycorrhizae in forestation is underway in different countries like Spain, Brazil, Australia, China, Germany, Canada and the USA.

In India, mycorrhizal technology has a great potential in afforestation of Bauxite mined areas with fast growing trees. In Himachal Pradesh (Amarnath) and Orissa (Koraput), planting of Chir pine (*Pinus roxburghii*) and Caribbean pine (*Pinus caribaea*) seedlings with adequate mycorrhizal development on roots induced by natural soil inoculum has been successfully achieved with high field survival and good growth. However, the work needs to be expanded further by inoculating seedling roots with specific mycorrhizal fungi, possibilities of which are under exploration.

VESICULAR-ARBUSCULAR MYCORRHIZA

In the species-rich grassland communities of the temperate and sub-tropical regions of the world, as in most tropical forest ecosystems, the majority of plants have vesicular-arbuscular (VA) mycorrhizal infection. This mutualism is extensively distributed through out the plant kingdom (Newman and Reddell 1987). It is predominantly associated with ecosystems in which phosphorus is the major growth limiting nutrient. The name 'vesicular-arbuscular' refers to the production by the fungus of distinctive structures, 'vesicles', and 'arbuscules' within the root. The former store carbon for use by the fungus, while the latter facilitate transfer of nutrients, in particular phosphorus, from soil through fungus to plant. The VAM symbiosis begins with germination of large spores, or other forms of inoculum propagules, such as root fragments, that occur in most soils as a result of their production and release into the soil from previous host roots. Spores germinate to produce germ tube-mycelium which penetrate the root cortical cells, forming arbuscules within the cells. Later vesicles are also formed in between and in the cortical cells. VAM fungi have extremely broad host ranges. They colonize the roots of approximately 90% of all plant taxa including most agriculturally important agronomic and horticultural crops (e.g. corn, cotton, soybean, citrus, grape, etc.). The fungal species responsible for the formation of VAM are placed in the Glomales of Class Zygomycetes (Walker, 1992; Morton and Bentivenga, 1994).

Role of VAM Fungi in Forestation

The main stress factors in the tropics are drought and high temperature. The availability of relatively immobile mineral nutrients, such as phosphorus, is lowered when soil water potential decreases. The hyphae of VAM fungi serve as extensions of the root systems and are both physiologically and geometrically more effective organs of absorption than the root themselves. Thus VAM-fungal associations appear to be necessary for growth and survival of plants in dunes, deserts, semi-arid and arid lands (Arnes and Vilarino, 1991; Jagpal and Mukerji, 1991; Mukerji and Jagpal, 1987; Mukerji and Kapoor, 1987; Mukerji and Dixon, 1992; Kuhn *et al.*, 1991; Bellgard, 1991; Dodd *et al.*, 1990). VAM fungi can adapt to a wide range of soil water regimes and can be found in extreme habitats. Several authors have reported the relation between soil moisture levels and mycorrhizal association in many plants (Graham *et al.*, 1987). VA mycorrhizal plants are less susceptible to wilting and transplant shock in low level of soil moisture. VAM fungi are believed to improve the water relations of host plants by increasing hydraulic conductivity (Hardie and Leyton, 1981), increasing transpiration rate and lowering stomatal resistance (Koide, 1985) or by altering the balance of plant hormone (Allen *et al.*, 1982). These reported changes could be secondary responses to better phosphorus nutrition (Michelsen and Rosendahl, 1990) or mediated via direct mycorrhizal effects (Henderson and Davies, 1990). Data on the influence of VAM fungi on drought resistance of tropical trees are very scarce (Osonubi *et al.*, 1991). Michelsen and Rosendahl (1990) working on *Acacia nilotica* and *Leucaena leucocephala*, demonstrated the potential of VAM inoculation in the reforestation of degraded areas in the tropics. Water relations of *Leucaena leucocephala* a common exotic in plantations and agroforestry systems in the sub-humid tropics, improved with mycorrhizal inoculation (Huang *et al.*, 1985). The serious drought stress to which seedlings are exposed in the sub-humid to arid tropics, e.g., during transplantation, may be alleviated by mycorrhizal inoculation. Experiment by Ellis *et al.* (1985) confirmed that there is a significant long-term effect of VAM on wheat drought tolerance. Vesicular-arbuscular mycorrhizae holds tremendous potential for use in the reclamation of arid and semi-arid lands where chief goal is maximum plant establishment and growth at minimum cost (Allen 1988). However, considering the potential importance of these organisms in the forestation programmes, research regarding VA mycorrhizal fungi and their relationship to ecosystem recovery appears to be promising indeed. VAM fungi have not yet been routinely applied in forestry or land reclamation, although commercial development is in progress. In general, fundamental information regarding, the ecological importance of VA mycorrhizal interactions in semi-arid lands is very limited and is considered to be urgently needed research.

VAM Inoculum Production

Before VAM can be utilized in large scale agricultural or forestry operations, a reliable and consistent source of inoculum must be available. VA fungi have been introduced into soil as soil pellets containing a mixture of colonized root fragments, infested soil, mycorrhizal roots with external mycelium and/or spores obtained from pot cultures. Because it is difficult to culture VA fungi axenically, practical VA inoculation is at present restricted to nursery level. Mosse and Hayman (1980) calculated that the amount of inoculum required to inoculate 1 ha. is impractical to produce, handle or transport. Thus as long as VA fungi cannot be cultured *in vitro* or suitable techniques for field inoculation are not developed, the practical application of VAM in fields will be severely limited (Whetten and Anne, 1992; Wood, 1992).

CONCLUSIONS

It has been established beyond doubt that the mycorrhizal fungal symbionts play a crucial role in the nutrient acquisition of their host plants. But we need much more information on the physiology and ecology of the mycorrhizal fungi. We also need more knowledge about the regulatory and functional processes of the symbiosis like the actual transfer of nutrients between the two symbionts. The ultimate answers to these questions may be of great significance to practical forestry. Ectomycorrhizal technology — the selection, propagation, manipulation and management of superior strains or species of ectomycorrhizal fungi — can make a critical contribution to the success of reforestation programme. However, the area of research regarding role of VAM fungi in forestation is relatively new and is severely hampered due to the inability of VAM fungi to grow axenically. A great deal of basic and practical knowledge must be developed if mycorrhizal technology is to be fully utilized and integrated into existing forestry programmes.

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Commercial Propagation Techniques of Tamarind Clones

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INTRODUCTION

Tamarind (*Tamarindus indica* L.) is an important tree of the tropics. It provides pulp, fuel-wood, timber, fodder and seeds for industrial uses. In India, it is grown in avenues, backyards and wastelands without much care and management. The fruit pulp is the most important part and is used to season many foods and also possesses a medicinal value. The seeds of tamarind contain proteins, and are of high biological value.

In spite of being cross pollinated, tamarind is commercially propagated by seeds. As a result of this practice, wide variability exists. Non-availability of elite planting material is the main reason for its low productivity. Identification of superior genotypes and their multiplication through vegetative methods are inevitable to supply genetically superior and uniform plant material. There is a need to develop easy, rapid and cheap method of propagation with high rate of success. In this background, an attempt was made to identify superior genotypes and efficient propagation method.

MATERIAL AND METHODS

A survey was undertaken across eight different agro-climatological zones of southern Karnataka. Elite tamarind trees were selected based on plant vigour, fruit quality, early fruit set and resistance to pest and diseases. Different propagation techniques, viz , cutting, air layering and grafting were assessed for their efficiency. The trial was conducted at the University of Agricultural Sciences, GKVK, Bangalore during the year 1992. Air layers were prepared on elite tamarind clones using growth regulator NAA (Napthalene Acetic Acid). All the treatments were replicated five times and completely randomised design was followed. The rooted layers were separated after 70 days from the mother plant and planted in polythene bags filled with rooting mixture. Observations on rooting percentage, root number and root length were recorded.

RESULTS AND DISCUSSION

About 282 trees of 40-45 years of age were surveyed at 8 different agro-climatic zones of southern Karnataka. The details of the number of trees collected under each location is presented in the Table-1. The success was more in air layers

Table-1: Number of genotypes surveyed in southern Karnataka

SI No	Name of the District	Taluk	No of trees
1	Bangalore	Kanakapura	36
2	Chitradurga I	Holalkere	30
3	Chitradurga II	Hiriyur	33
4	Kolar I	Chintamani	37
5	Kolar II	Mulabagal	42
6	Mandya	Nagamangala	29
7	Shimoga	Channagiri	38
8	Tumkur	Kunigal	37

compared to cuttings and graftings. Ganapathi (1988) also reported similar results. So the method was evaluated for mass multiplication of tamarind clones. The results showed that there were significant differences among the treatment for rooting percentage. The layers treated with NAA 7500 ppm recorded maximum percentage of rooting (96%) followed by NAA 5000 ppm (80%) (Table-2). The minimum percentage of rooting (36%) was recorded in

Table-2: Effect of growth regulator (NAA) on rooting percentage, root number and root length of tamarind air layers

Treatment	Rooting percentage	Root number per layer	Maximum root length (cm)
Control	36.00%	14.80	4.00
NAA 10000 ppm	60.00%	18.20	7.00
NAA 7500 ppm	96.00%	21.20	9.20
NAA 5000 ppm	80.00%	16.80	7.60
NAA 2500 ppm	72.00%	16.80	7.40
NAA 1000 ppm	48.00%	18.40	5.00
CD at 5%	17.79	N.S	2.31

control. Regarding root characters, the layers treated with NAA 7500 ppm recorded highest root number per layer (21.20) and also maximum root length (9.20 cm), whereas the lowest number of roots (14.80) and minimum root length (4.00 cm) were recorded in control. This indicates the commercial feasibility of growth regulator NAA for mass multiplication of tamarind through air layers. Raising of orchards through air layers exhibit uniformity in growth and yield besides getting good quality of fruits. The clones came to maturity earlier as compared to ones which are propagated through seeds. Since mode of marketing or sale of tamarind fruit is by auctioning, the trees of clonal orchards fetch

more premium because the yield can be easily predicted unlike the seed raised orchards (Kulkarni *et al* , 1992a and Kulkarni *et al* , 1992b). Thus development of orchards through air layers of known genotypes assures farmers a good economic returns.

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Micropropagation of *Nyctanthes arbor-tristis*

Sanghamitra Bhattacharya and Sabita Bhattacharya

INTRODUCTION

Nyctanthes arbor-tristis L. (Family Nyctanthaceae) is a small deciduous tree, commonly planted in gardens for its fragrant flower "night jasmine". *N. arbor-tristis* has been recognised as one of the Indian medicinal plants for various medicinal uses, obtained from its different parts (Anonymous, 1966; Watt, 1972 & Ramachandran *et al*, 1986). Recently the plant has drawn the attention of scientists, because of its two iridoid glycoside compounds — Arbortristoside A and Arbortristoside B (Purushothaman *et al*, 1985 & Susan *et al*, 1986) which are found to possess anticancerous properties (Susan *et al*, 1986). Anti-fungal, insecticidal, antiallergic, antipyretic, analgesic, ulcerogenic, antiinflammatory activities of its leaf extracts have also been reported. (Tewari & Nayak, 1991; Pandey *et al*, 1982, Gupta *et al*, 1993 & Suxena *et al*, 1987 & 1984). Being a source of medicines for diverse diseases, the need has emerged to ensure growth of this plant in much larger number in keeping with the increasing interest evinced by people towards herbal medicine.

The objective of the present study is the propagation of *N. arbor-tristis* plant on a large scale within a short duration using micropropagation technique, so that it will add extra measure over the natural means via seed germination. It is relevant to mention that the percentage of seed germination of this night-blooming plant is found to be considerably low (unpublished data).

MATERIALS AND METHODS

An adult tree of *Nyctanthes arbor-tristis*, grown in the garden of Bose Institute was selected as the stock plant. Young branches were collected, from each of which 0.5-1 cm long segments from the tip with apical meristems and 0.8-1 cm long segments from the nodal zone with axillary buds were cut to use as experimental explants. These were cleaned in running tap water for 15 min., then with distilled water containing a few drops of 'Teepol' detergent solution by gentle stirring in a magnetic shaker for 10 min. followed by thorough washing with distilled water. Surface sterilization was carried out with 0.1% HgCl_2 (w/v) for 5 min. and explants were washed 10 times with sterile distilled water. Apical meristems, covered by two juvenile leaves were used directly without any incision but leaves of the nodal segments were trimmed exposing the points of

axillary buds. Both types of explants were placed erect, singly, per culture tube, on MS medium, containing 3% sucrose, 0.8% Bactoagar and pH adjusted to 5.6 before autoclaving. The culture media were supplemented with 3 different concentrations of BAP (1.0, 2.0 and 3.0 mg/l) singly or in combination with NAA (0.2, 0.5 or 1.0 mg/l) for shoot induction (proliferation medium). After 4 weeks one more sub-culture of the individual explants with *in vitro* proliferated shoots was carried out on the same medium for another 4 weeks. Initiated shoots attaining about 1 cm height were then transplanted on White's medium (White 1943) supplemented with BAP (2 mg/l) and NAA (0.2 mg/l) for shoot elongation (growth medium). Micropropagated shoots, 2-3 cm in height were transferred to 'rooting medium' comprising of Knop's salt solution (Knop 1984) supplemented with 1% sucrose and IBA (3 mg/l) and solidified with 0.7% Bactoagar. The cultures were grown under a 16 hr. photoperiod with a light intensity of 9 ergs/cm³ provided by Philips white fluorescent tubes. Each experiment was carried out with 30-40 explants excluding the contaminated ones, and repeated 3 times.

RESULTS AND DISCUSSION

Explants of *Nyctanthes arbor-tristis* containing nodal segments responded more favourably (as revealed by the higher percentage - Table-1) than those with apical meristems. Shoots emerged by breaking axillary buds in nodal segments, followed by the development of another two from the base of the former ones (Fig. 1) whereas the first sign of the response of the apical meristem is the swelling of the apical dome and subsequent emergence of small shoot initials on it (Fig. 2). Within 2 weeks, initiation of new shoots became prominent in both types of explants. The main difference between the apical meristematic tissue-originated shoots and axillary bud-emerged shoots was that in the former case shoots grew in very close association with each other (Fig. 3a & b) with basal parts having a tendency of callusing, resulting in slow growth of the regenerated shoots which is a basic disadvantage of culturing this kind of explants. Cytokinin like BAP singly in the medium was not sufficient for proliferation, 2.0 mg/l BAP was found best of all the 3 concentrations tested when combined with 0.2 mg/l NAA (the proliferation medium) (Table-1). After 8 weeks culture (including one sub-culture after 4 weeks), in the same nutrient combination more than 10 shoots were obtained from one single culture. Increasing BAP concentration (above 2.0 mg/l) or NAA (above 0.2 mg/l) in BAP-NAA combination caused callusing of the whole explant (Table-1).

For further growth and development of shoots, cultures required a change in the basal medium and its sucrose concentration, i.e., from MS +3% sucrose to White's +2% sucrose without altering the combination and concentration of the hormone supplement used previously in the proliferation medium (i.e. BAP 2.0 mg/l + NAA 0.2 mg/l). Analysis of the composition of the two media — MS and

Table-1: Effect of Different Hormonal Treatments on Shoot Development from Apical Meristem (A M) and Nodal Segment (N S) of *Nyctanthes arbor-tristis* cultured in MS Medium

concentration of hormones treatment (ng/l)	After 4 weeks culture			After 8 weeks of culture		
	Percentage of responding cultures			Average (*) number of shoots per culture		
	A M	N S		A M	N S	Average length of longest shoot in (cm)
IAA	BAP					N S
10	24.3	58.2		2.0	2.0	0.405
20	35.3	64.4		4.2	2.0	1.0
30	52.1 Cal (**)	69.2 Cal		-	-	-
BAP						
20	33.8	60.0		8.4	10.4	0.4
50	36.3 Cal	62.8		3.5	6.5	0.2
0	18.7 Cal	-		-	-	-

*) Data on the average of 10 selected cultures

**) Regeneration started initially but explant callused at the later stage



- Fig. 1:** Shoot regeneration from nodal segment of *Nyctanthes arbor-tristis* by breaking axillary buds, maintained in 'proliferation medium'
- Fig. 2:** New shoot bud emergence (pointed by arrow) of *N. arbor-tristis* from the swelled tissue of apical meristematic dome containing pre-existing apical shoot bud at the middle (pointed by broken line)
- Fig. 3:** A number of young shoot apices of *N. arbor-tristis*—a) at early stage of development, b) at later stage forming a crowd in 'proliferation medium' after 8 weeks culture
- Fig. 4:** Two closely originated healthy shoots of *N. arbor-tristis* cultured in 'growth medium'
- Fig. 5:** One young, properly rooted shoot on *N. arbor-tristis* after 4 weeks of culture in 'rooting medium'

White's and sucrose concentration used in the experiment reveals that the higher level of salt concentration and carbon source is necessary for shoot regeneration and their growth upto a primary stage (10 cm, length) (Table-1). This culture condition had little effect on further growth and elongation of shoots. Shoots attained a height of 3-4 cm in the culture tubes (Fig. 4) while culturing in the 'growth medium' for the next 4 weeks.

Regenerated shoots of *N. arbor-tristis* rooted in rooting medium comprising of Knops salts and IBA (3 mg/l) (Fig. 5)

The achievement of the present study is the establishment of an effective procedure which can be utilized for developing the medicinally important plant, *Nyctanthes arbor-tristis* on large scale for field cultivation. This research also provided necessary information on *in vitro* culture of this species because at present, reports are nil on the subject (as evident by current computer search)

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***In Vitro* Cloning of *Michelia champaca* L. (Family Magnoliaceae)**

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INTRODUCTION

There has been an increasing interest in recent years in the application of tissue culture techniques as an alternative means of propagation of economically important plants. Success in obtaining viable plantlets from mature forest trees has been more recent. Multiplication of adult plants of proven performance is often very difficult or impossible in many woody species. This is due to their very slow rate of growth as well as the chance of character dilution in nature. Meristem, shoot tip or bud culture provides an excellent alternative tool to overcome these problems and success has been achieved in a number of genera by this technique (Gupta *et al.*, 1980, 1981a, 1981b; Jones, 1991, Kulkarni *et al.*, 1981; Lloyd & McCown, 1980 & Nadel, 1991.)

Michelia champaca L. (Champak) of family Magnoliaceae is a tall, ever-green tree found in the foothills of north-east India, eastern Himalayas and western ghats. This is one of the most important timber yielding trees, wood of which is used for post, furniture, decorative fittings, ship building, etc. The plant also has immense medicinal importance. Alkaloids and tannins derived from bark, dried root and other plant parts are used for a number of medicinal purposes. The champaka oil obtained from its flowers is highly esteemed in perfumery (Anonymous, 1962). In spite of its said importance, this particular woody plant is still relatively unexplored by modern tissue culture techniques. Conventional methods of propagation of this plant are by natural regeneration around mother trees and artificially by sowing fresh seeds or by various grafting techniques. As a result, elite characters are diluted in a forest population. To avoid this problem and to achieve the production technology of only "elite" trees, we are standardizing the method to derive true-to-type clones from selected elite plant. To minimise the chance of character dilution we have avoided the route via callusing and succeeded in employing direct shoot tip culture technique by using shoot buds as explant collected from a "plus" or "elite" donor tree. This paper describes some results relating to the optimization of physical and chemical factors of culture media for successful establishment and multiplication of explants.

MATERIALS AND METHODS

Plant Material

Both axillary and terminal shoot buds collected from an elite *M. champaca* plant of 30-32 years, were used as explants. The source plant was identified at Hijuli, Ranaghat by the Krishnanagar forest range office, W. Bengal, India. Buds with considerable stem portions (about 3-4 cm) were cut mainly from the newly emerging branches of the source plant during every month of the year and immersed immediately in sterile Murashige and Skoog's (MS) salt solution (Murashige & Skoog 1962) and kept in ice bucket. Following repeated rinsing in tap water, liquid soap water and distilled water, the buds were trimmed to a suitable size (about 2 cm) and were subjected to magnetic stirring with frequent changes before further treatment for sterilization. Explants were finally surface-sterilized with 0.5% HgCl_2 (w/v) along with 0.01% Teepol (v/v) for 10 minutes and then washed thoroughly with sterile distilled water for at least three times. This procedure produced 70 - 80% aseptic cultures. The sterilized buds were further trimmed to 10-15 mm in length with 2-3 leaf primordia and inoculated in sterile culture media (10 ml—containing 0.8% agar in 25 mm × 150 mm culture tubes). Only the terminal buds with above mentioned specifications responded to culture conditions while the axillary buds proved unsuitable.

Basal Media

The following basal media were tested: MS, 1/2 and 1/4 strength of MS, Linsmaier and Skoog's (LS) (Linsmaier & Skoog 1965), Gamborg's (B5) (Gamborg *et al.* 1968), White's (WH) (White 1963), Anderson's (ABM) (Anderson 1975), and Woody Plant Medium (WPM) (Tremblay & Lalonde 1984).

pH of the Culture Media

Culture media with 4.5, 4.75, 5.0, 5.25, 5.50 and 5.75 pH were used for experiments.

Carbon Source of Culture Media

Different carbon sources like sucrose, glucose, fructose, sorbose and mannitol were used. Several concentrations (like 30 gm/l, 40 gm/l, 50 gm/l and 60 gm/l) of sucrose, the most effective carbon source found, were tested in other experiments with or without growth regulators.

Growth Regulators

For optimization of growth regulators effects of (a) two cytokinins (Kinetin and

Benzyl Amino Purine, BAP); concentrations being 0.1, 0.5, 1.0, 1.5, and 2.0 mg/l; (b) two auxins (Indole-3-Acetic Acid, IAA and α -Naphthyl Acetic Acid, NAA); concentrations being 0.01, 0.05, 0.1, 0.5 and 1.0 mg/l were studied in establishment media, and (c) a pretreatment of explants in Gibberelic Acid (GA_3 , 1.0 mg/l) containing media for 7 days and then transfer to BAP and NAA containing media was also carried out for internodal elongation. In the experiments prior to the standardization of appropriate concentration and combination of growth regulator BAP and NAA with a fixed ratio (1:1) was always used.

Other Cultural Conditions

All cultures were maintained in a growth room at $25^\circ\text{C} \pm 1^\circ\text{C}$ with 78% humidity and a 16 hr photoperiod with cool white fluorescent light (9 watts/cm²). Shoot elongation and leaf emergence were recorded during the culture period of 28 days. All experiments were performed using 20 buds per treatment in separate culture vessels, and were repeated with little or no modifications at different seasons of the year, depending on the availability of explants from the source plant.

RESULTS AND DISCUSSION

Basal Media and pH of the Culture Media

Out of the eight basal media tested, the MS medium was found to be most suitable in terms of percentage of response and explant elongation. Gamborg's medium (B5) was also found effective to some extent while the media with low salt concentrations did not provide proper establishment of the explants (Table-1). On the other hand, when experiments were carried out to optimize the appropriate pH requirement of *Michelia* shoot buds in culture, it was observed that a slightly acidic (pH ranging between 5.0 to 5.25) media was more suitable (Fig. 1a).

Table-1: Effect of different basal media on shoot bud establishment of *Michelia champaca* L. (All media were supplemented with a combination of BAP and NAA (1:1). Results were recorded after 21 days of inoculation)

Basal media	% of response	Mean increase in length (mm)	No. of axillary buds proliferated per explant	No. of leaves emerged per explant
MS	80	11.25	2	2
1/2 MS	60	5.33	1	0
1/4 MS	60	4.6	0	0
LS	40	4.25	1	0
B5	70	10.25	1	1
WH	0	0	0	0
WPM	40	5.5	0	0
ABM	60	7.2	1	1

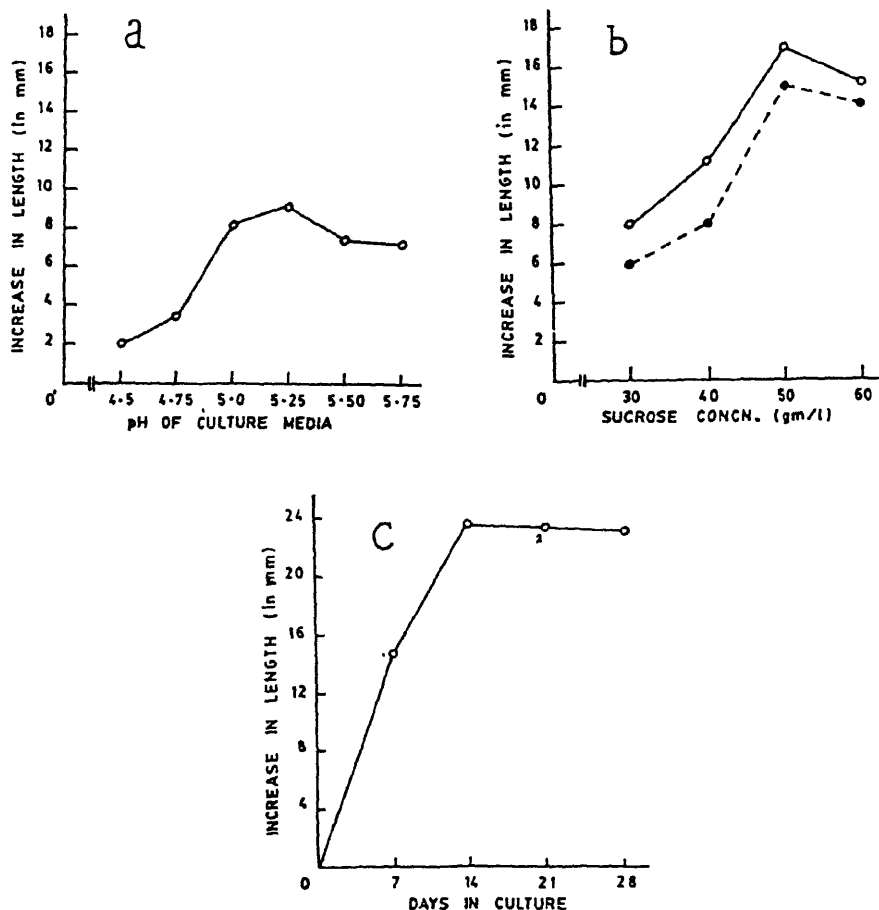


Fig. 1a Effect of different pH of culture media on *Michelia* shoot bud establishment MS basal media supplemented with 30 gm/l sucrose and a combination of BAP and NAA (1:1) were always used in each case Results were recorded after 14 days of inoculation to respective culture media

Fig. 1b Effect of different concentrations of sucrose on *Michelia* shoot bud establishment either in presence of growth regulator (BAP and NAA, 1:1) (O—O) or without it (●—●) in culture media Basal media used were MS, results were recorded after 21 days

Fig. 1c Initial elongation of *Michelia* shoot buds due to a pretreatment with GA_3 (1.0 mg/l) in culture media for 7 days MS basal media supplemented with 50 gm/l sucrose were used

The physiology of plants *in vitro* was studied in relation to their known growing requirements *in vivo*, with an attempt to increase the effectiveness of micropropagation by developing more suitable media than the relatively narrow range in common use. Positive correlations had been found between growing conditions *in vivo* and culture medium requirements *in vitro* (Jones 1991). *Rhododendron*, *Kalmia*, and *Magnolia*, the woody plants which grow well on poor and often acidic soil had shown their preference to low concentrations of nutrients *in vitro* and some had also been benefited from a reduction in the pH of culture media (Marks 1986).

The appropriate culture requirements of *Michelia* as per our findings were interesting as the explants attained better establishment in case of medium with high inorganic salts like MS or B5 but rate of establishment was more only when the pH range of culture medium was lowered simultaneously.

Carbon Source

Sucrose in a relatively high concentration (50 gm/l) provided the optimum carbon requirement for *Michelia* shoot buds. It was also observed that culture media with this level of sucrose induced establishment of explants even in the absence of any growth regulator. Hormone containing media, however, brought better response in terms of explant elongation as well as leaf unfolding (Fig. 1b).

When separate experiment was conducted to find out the best carbon source for establishment, the effects of glucose, fructose, sorbose and mannitol were studied in comparison to sucrose (50 gm/l) of the same osmotic potential. It was observed that besides sucrose, this plant had preference towards glucose and fructose also but not towards sorbose or mannitol. Sucrose with a concentration of 50 gm/l, however, showed the most significant results (Table-2).

Table-2: Response of *Michelia champaca* L. shoot buds due to the effect of different carbon sources applied in establishment media (MS basal media supplemented with BAP and NAA were used in each case)

Carbon source	% of response	Mean increase in length (mm)	No. of axillary buds proliferated per explant	No. of leaves emerged per explant
Sucrose	80	17.0	2	2
Glucose	70	14.6	1	0
Fructose	80	14.4	2	0
Sorbose	0	0	0	0
Mannitol	0	0	0	0

It is well established that the most widely used carbon source in tissue culture media is sucrose. However, other sources have been tried by several workers in a number of plant species with success. Tremblay and Lalonde (1984) showed

that the most suitable carbon source for *Alnus* sp. was glucose. Even, sorbitol and mannitol, the sugar alcohols, had been found to be very much effective for *in vitro* *Malus* and *Syringa* shoot multiplication (Welander *et al.*, 1989). They further demonstrated that the capability to metabolize a certain type of carbon source in *in vitro* culture by a plant was reflected by the sugars and the sugar alcohols reported in the sieve tube exudate (Zimmermann & Ziegler, 1975). The affinity of *Michelia* shoot buds towards high concentrations of sucrose was quite expected as this form of carbon source is the prevalent one found in the sieve tube exudates of the members belonging to the family Magnoliaceae (Zimmermann & Ziegler, 1975). That it showed positive response in either glucose or fructose containing media also was probably due to the fact that they are nothing but the two monosaccharides constituting sucrose which dissociated during autoclaving and readily transported by diffusion across the cut stem surfaces.

Growth Regulators

For the establishment media, a combination of BAP and NAA, both of same concentration (0.1 mg/l) was found optimum. Kinetin, the other cytokinin tested was also found effective to a large extent (Table-3). High concentrations of both the cytokinins induced axillary bud proliferation and emergence of leaves from the explants. However, when the ratio of cytokinin and auxin was altered by using elevated concentration of auxin, no axillary bud emerged out of any explant and leaves, though unfolded, but they were swelled in nature with the tendency of callusing (Table-4). From a separate experiment, it was found that

Table-3: Effect of two cytokinins (BAP and Kinetin) on shoot bud establishment of *Michelia champaca* L. (MS basal media supplemented with fixed concentration of NAA (0.1 mg/l) were used in each case)

Cytokinins	Concns used (mg/l)	% of response	Mean increase in length (mm)	No. of axillary buds proliferated per explant	No. of leaves emerged per explant
Kinetin	0.1	70	10.4	1	1
	0.5	60	10.5	1	1
	1.0	60	9.0	1	0
	1.5	40	8.25	0	1
	2.0	40	8.6	1	0
BAP	0.1	80	12.0	2	2
	0.5	80	7.6	2	1
	1.0	60	7.0	1	0
	1.5	50	6.8	2	0
	2.0	40	6.5	1	0

GA₃-induced elongation of shoot buds was not advantageous as internodal elongation occurred only in initial stages of culture but the explants did not grow further after 14 days (Fig. 1c).

The requirement of both a cytokinin and an auxin for *Michelia* shoot bud establishment is quite evident as 85% of the establishment media listed by Hu and Wang (1983) for different plant species were supplemented with a cytokinin and out of this not less than 68% were benefited by the appliance of BAP either alone or in combination. It is unlikely that the meristem, shoot tip and bud explants have sufficient endogenous cytokinin to support growth and development *in vitro* as roots are the principal sites of cytokinin biosynthesis. Though young shoot apex is an active site for auxin biosynthesis, exogenous auxin is reported to be needed for the establishment media (Dale 1975), particularly when large sized explants are not used. That axillary bud proliferation is triggered when cytokinin is more than auxin but not the vice versa is well known. Swelling and tendency of callusing of the emerged leaves when more auxin was applied is so also explainable.

Table-4: Effect of two auxins (IAA and NAA) on shoot bud establishment of *Michelia champaca* L (MS basal media supplemented with fixed concentration of BAP (0.1 mg/l) were used in each case)

Auxins	Concns used (mg/l)	% of response	Mean increase in length (mm)	No. of axillary buds proliferated per explant	No. of leaves emerged per explant
IAA	0.01	0	0	0	0
	0.05	0	0	0	0
	0.1	40	8.5	0	1
	0.5	40	7.5	0	1
	1.0	20	5.5	0	0
NAA	0.01	20	6.0	0	0
	0.05	60	8.3	0	0
	0.1	80	12.0	2	2
	0.5	40	8.5	0	2*
	1.0	40	7.3	1	1*

* Callusing of the emerged leaves

Finally, the protocol standardized by us for shoot tip culture of *Michelia champaca* L upto the stage of multiplication can be summarized this way. The explants require conditioning of two repeated transfers (one in M1 and other in M2 media) to attain the establishment stage. The established shoots further require sequential treatment of BAP during two transfers in multiplication media (M3 and M4) to give rise to 3-4 proliferated axillary shoots in almost

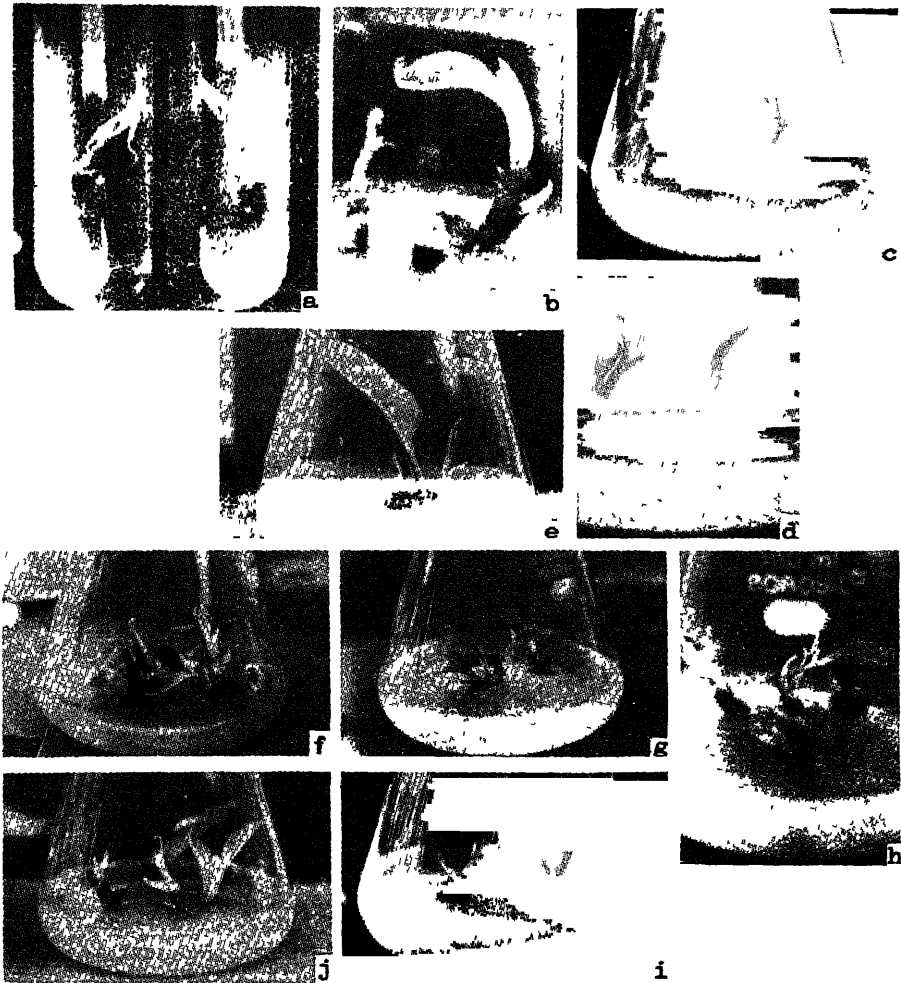


Fig 2. Photomicrographs of different stages of establishment (a-e) and multiplication (f - i) of *Michelia champaca L.* shoot buds in culture

every explant. Starting with a single bud, around 15 proliferated shoots can be produced within four months as shown in the flow diagram (Fig 3). This procedure can be scaled up to produce the desired number of buds/plantlets by repeating the same cycle. Experiments to induce rooting of the plantlets are under way.

Starting material = one shoot bud

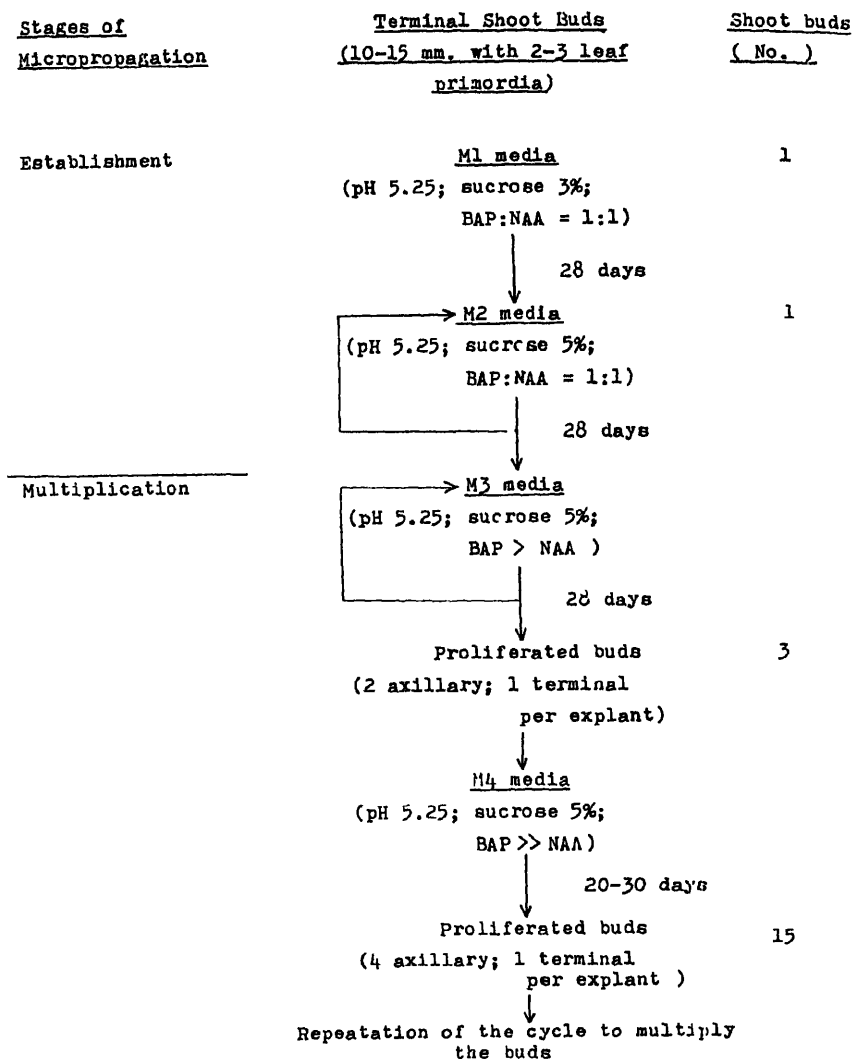


Fig 3 Flow chart for *in vitro* clonal propagation of *Michelia champaca* L.

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***In Vitro* Propagation of Cane (*Calamus rotang* Linn.)**

Amitava Roy, P.K. Saha, B.B. Mukherji and S. Gupta

INTRODUCTION

Cane (*Calamus rotang* Linn.) is a shrub of tropical rain forests mainly found in moist and shady places. The plant has often been used in multi-tier silviculture practices as a lower tier member and has been categorised as a minor forest product (M.F.P). The plant is used in furniture, wickerwork and basketry. The plant reproduces through vegetative propagation by germination of adventitious buds present in the corm which requires minimum plant age of 3-4 years. Moreover, the reproduction is season-dependent and the plantlets produced, are very small in number. Propagation through seed is also low.

Tissue culture techniques are becoming increasingly popular as an alternative means of vegetative reproduction (Choo, 1990). A large number of plantlet production would be possible within a short period of time by *in vitro* clonal propagation. This technique can also be utilised for germplasm conservation of several types of Cane available (Anonymous, 1986, Renuka, 1990). *In vitro* propagation of several genotypes of family Arecaceae have been reported (Tisserat, 1980; Eeuwens, 1978). Leaf sheath, petiole and stems have been successfully used for development of plantlets in Date palm (Tisserat, 1982). Axillary and adventitious buds from few monocot plants have been reported for direct embryogenesis (Hussey, 1976).

The present paper reports on explant establishment and development of multiplication technique in *in vitro* culture.

MATERIAL AND METHODS

Calamus plant aged between 4-5 years were selected from Hizuli forest, Ranaghat, under Krishnanagar forest division, West Bengal, India. Plantlets developing as suckers derived from mother plant, were carefully excised with rhizome roots intact, after removing the soil. The explants were treated with mild surfactants over a magnetic stirrer for 15-20 mins and washed with distilled water twice. The leaf bases were removed acropetally one after the other and the size of the explants was reduced to 6-7 cm. The explants were dipped in an antioxidant solution (PVP 0.5% w/v) prior to surface sterilization. Several

chemicals (Ethanol 70%, Polar liquid bleach, Potassium permanganate, Sodium hypochlorite and Mercuric chloride) were used singly or in combination for surface sterilization.

In double sterilization, explants were treated in Sodium hypochlorite (5.0% v/v) for 5-7 mins. and then washed in sterile water (X3). Further, the explant was dipped in Mercuric chloride (0.5% w/v) with two drops of Teepol (0.01%) as surfactant. Explants (X3) were finally washed with sterile water and then cut to appropriate size before transferring them to the medium.

Euwens Y3 medium (1976) supplemented with 2,4-dichlorophenoxyacetic acid (2,4-D)-5 mg/l and 6-Benzyl amino purine (BAP) 1.2 mg/l with Sucrose (5.0% w/v) was used for establishment of explant. Activated charcoal (0.3% w/v) was added as an absorbent in the medium. The explants were sub-cultured after each culture cycle of 30 days. Different concentration of auxin and cytokinin was used during multiplication.

The cultures were maintained at $25 \pm 2^\circ\text{C}$ in 16 hrs photoperiod. Light was supplied by a white fluorescent tube-light, with 9 watt/cm^2 intensity and 78% relative humidity.

RESULTS AND DISCUSSION

Single treatment with Sodium hypochlorite (5.0% v/v) or Mercuric chloride (0.5%) gave rise to 45% and 15% contamination-free responding explants respectively. Response at initial stage means the growth of explant and emergence of 1st green leaf. Double sterilization (Sodium hypochlorite and then Mercuric chloride) showed 55% contamination-free responding explants. Utilization of two different sterilizing agents sequentially, have also been reported by Choo (1990). However, systemic pathogens sometimes appeared on the explants surface 22-24 days after inoculation. In Oil palm (*Elaeis guineensis* Jacq), it was reported that contamination rate was reduced by selecting rapidly growing plants (Staritsky 1970). In the present study, explants selected from vigorously growing *Calamus* plants showed a quick establishment and absence of systemic contamination.

During culture, browning at cut ends of the explants occurred within 1-2 days, with retardation of growth. When the explants were treated with PVP (0.5% w/v) and then transferred to medium containing 0.3% (w/v) activated charcoal, normal growth was observed. In *Phoenix* sp. quick explant browning was prevented by dipping the explant in an antioxidant solution prior to surface sterilization (Tisserat, 1982; Shaheen, 1990). The greenish-white explant, when transferred to the Y3 medium supplemented with 2,4-D (5.0 mg/l) and BAP (1.2 mg/l), showed browning at the outer leaf sheath, however the inner bases elongated and proliferated. Sub-culture of the developing explants after 30 days in similar medium led to emergence of leaflet and rachis within 35-40 days.



Fig. 1: A Juvenile cane plant, B-G *In vitro* development of explant

During rapid plant propagation in *in vitro* culture, appropriate selection of size of explant is essential. In this case, 98% of the small explants (0.5 cm) turned brown quickly within 2-4 days and failed to respond. Explants (2.5-3 cm) containing more than 3-4 leaf bases showed 20% response for growth, but were prone to contamination. Explants ranging between 1.5-2.0 cm showed maximum increase in length (1.1 cm within 30 days). Unsuitability of large-sized explants have also been reported by other workers (Murashige, 1974, Shaheen, 1990, Choo, 1990).

When explants of 1.5-2 cm size were inoculated in the same medium under identical conditions, variation in growth and development was observed. To obtain uniformity in growth response, explants from suckers of four different lengths (10, 10-20, 20-30, and 30-40 cm) from a 5 year old plant were

transferred in establishment medium 10-20 cm long sucker, showed a 10-12% establishment with similar growth rate (1.2 cm/30 days).

Cane being a monocot, does not have lateral cambial layer or axillary branching (Sharma *et al.*, 1980; Anonymous, 1950), therefore multiplication of the established explant is difficult. Attempts for clonal propagation was restricted to induce axillary and adventitious buds, without any intermediate callus phase. The established explants were placed in the medium rich in cytokinin (BAP 5.0 and 10.0 mg/l). The axillary meristem (0.5-2.0 cm) in form of buds were in close proximity to the basal dome shaped meristem and got easy access to the nutrient medium. It was observed that in 5.5% BAP explant initiated axillary bud growth, but when these buds were maintained in the same medium, further growth of these buds was poor. Experiments with different combinations of hormones and other additives are in progress.

It was reported that rhizome of oil palm, bearing adventitious bulbs, when treated with high levels of BAP, showed bud proliferation (De Fossard, 1976). In the present study, only two cases, when the established explant was cultured in Y3 liquid medium (without agar) on filter paper bridge, led to axillary branching by breaking basal meristem plate. Later emergence of lateral roots made the branches detached and independent. Similar type of branching was also reported in Date palm (De Mason & Tisserat, 1980). Several techniques and methods applied for rapid multiplication are underway to find and standardize the rapid multiplication technique with this plant material.

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Seed Germination in *Terminalia arjuna*

N.G. Mulik and S.G. Patil

INTRODUCTION

Terminalia arjuna is a slow growing species, found wild in Maharashtra. It is known that *Terminalia* seeds germinate with difficulty. This indigenous species of *Terminalia* is one of the good sources of multi-use forest products. Many *Terminalia* species are now-a-days becoming extinct due to illicit cuttings and increasing urbanization. There is, therefore, an urgent need for suitable strategies for the conservation of such genes/genotypes. Establishment of germplasm bank of *Terminalia* species has also been proposed to declare the species as one of the 'national tree genus' to enforce protection of endangered genotypes in nature (P. Rajan *et al.*, 1993).

Keeping all this in view, a germination study was initiated in *Terminalia arjuna*. In the present piece of work, germination was studied under laboratory and field conditions as a function of the weight of the seeds. However, seed or fruit size itself is quite important ecologically. The present investigation is an analysis of the effect of seed-weight on seed germination and some other aspects.

MATERIAL AND METHODS

The fruits were collected from different localities of Kolhapur District. Seeds were selected and sampled randomly. Initially, more than 200 seeds were weighed. Then fruits were allotted as per the weight classmarks (1.0-1.5 g, 1.51-2.0 g, 2.1-2.5 g and 2.51-3.0 g). Germination experiments were initiated under laboratory as well as field conditions. Two replicates of 20 seeds from each classmark were set for germination. Different sets were designed as follows.

I. In Petri-plate Culture

- | | |
|---------|---|
| Set — 1 | Fruits (with wings) were kept as they are for germination, using moist filter paper (control) |
| Set — 2 | Fruits (with wings) were nicked by a cutter and then used for germination |
| Set — 3 | Fruits (with wings) were soaked for 24 hours in tap water and then germinated. |

Set — 4 Fruits (with wings) were germinated in petri-plates.

II. In Soil Culture

Set — 1 Fruits were sown directly in soil (polybag).

Set — 2 Fruits, after soaking for 24 hours were sown in soil (polybag).

RESULTS AND DISCUSSION

Seed (fruit) size itself is important eco-physiologically and most of the ecological arguments on seed size have been gathered by Haper (1977). In the present work, it was observed that 45% seeds weighed more than 3 grams. The size of the corresponding fruit was also found to be maximum (healthy fruits). Remaining fruits were recorded in the 1 to 2.5 category (classmark) and had a minimum to moderate size.

Table-1 depicts the percentage germination and effect of fruit size/weight on germination in *Terminalia arjuna* from different sets. It can be seen that maximum seeds germinated from all the sets at 2.5-3 class mark range. Lowest germination percentage were recorded from first class mark range (1 to 1.5 g). Thus, seed germination appears to be a function of seed size and seed weight as both are important ecologically. Similar studies have been carried out by Dolon (1984) in a population of *Ludwigia leptocarpa*. He also observed that the seed

Table-1: Effect of fruit weight on germination percentage in *Terminalia arjuna*

Set/Classmark	1 0-1 5	1 5-2 0	2 1-2 5	2 51-3 0
	(Germination % for each classmark)			
I <i>Petri-plate Culture</i>				
1 (Control)	20	40	20	100
2	10	60	20	60
3	23.6	60	40	100
4	10	20	30	60
II <i>Soil Culture</i>				
1	--	--	--	17
2	--	--	--	80

*Classmark represents fruit weight in grams

size has a considerable effect on per cent germination and time of seed germination.) Further, a significant difference was observed in the time of seed germination (Table-2). Nicked and soaked seeds required minimum days to germinate. Seeds from the set 2 and 3 with 2.5-3.0 g weight were found to germinate within six to seven days. The germination percentage was found to be low (10-20%) in the lower class mark range (1 to 1.5). From the Tables it is clear that as the fruit size increases, the germination percentage also increases.

and the average number of days required to germinate decreases. Classmarks 1.5 to 2 and 2.1 to 2.5 show fluctuating values. From the above observations, it is clear that seed size and seed weight apart from other aspects are also responsible factors for an efficient germination. Large fruit size does convey an advantage in growth.

Table-2: Effect of fruit weight on average timing of germination

Set/Classmark	Average number of days to germinate			
	1.0-1.5	1.5-2.0	2.1-2.5	2.51-3.0
I <i>Petri-plate Culture</i>				
1 (Control)	18	16	15	12
2	15	15	11	6
3	13	12	9	7
4	14	11	11	10
II <i>Soil Culture</i>				
1	--	--	--	10
2	--	--	--	6

Thus the present work suggests that it would be advantageous to sow only those *Terminalia arjuna* seeds which have a larger size and weigh more than 2.5 g. Apart from these two heritable characteristics other factors such as quantity of seed production, seed dispersal aids, soil fertility, etc., determine the reproductive success story of a plant.

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Effect of Dates of Sowing and Spacing on Growth and Yield of Kalmegh (*Andrographis paniculata* Nees)

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INTRODUCTION

Kalmegh (*Andrographis paniculata* Nees) of Acanthaceae family is an important medicinal plant and has been used in the Indian Systems of medicine since time immemorial. The plant is growing in the plains throughout India and Sri Lanka. The entire plant has medicinal properties of which the leaves are extensively used for extraction of drugs. Plant contains several diterpenoid compounds of which Andrographolide is important which is distributed all over the plant body in different proportions. At present it is being collected only from forest areas in which a lot of variation in the active principle contents could be seen, indicating the importance of cultivation in obtaining the drug of homogeneous potency. As no information on any aspect of its cultivation has been reported anywhere, an attempt was made to find out the suitable season and spacing for successful cultivation of this valuable medicinal plant.

MATERIAL AND METHODS

The experiment was conducted at the Horticulture Research Station, GKVK, Bangalore during 1993 to 94 using Split Plot Design with three replications. The experimental site is situated at an elevation of 930 m above MSL on latitude 12°58' North and longitude 77°35' East, with red sandy loam soil. The treatments consisted of 4 sowing dates (1st June, 1st July, 1st September and 1st October) and 3 spacings (15 × 15 cm, 30 × 15 cm, 30 × 30 cm). The seeds were sown in the polybags according to dates of sowing and fifty days old healthy seedlings were transplanted to the experimental plots as per the different spacing treatments. The crop was uniformly applied with 75 kg P₂O₅ and 50 kg K₂O per hectare and cultural operations like irrigation, weeding, etc., were attended regularly.

RESULTS

The data on the influence of different growth and yield parameters are presented in Table-1

Table-1: Effect of dates of sowing and spacing on growth and yield of Kalmegh (*Andrographis paniculata* Nees)

Treat- ments	Plant height (cm)	Plant Spread (cm ²)	No of bran- ches	No of leaves	Yield/plant		Yield/plot		Yield/ha		Androg- rapholi- de cont (%)
					Fresh (g)	Dry (g)	Fresh (g)	Dry (g)	Fresh (t)	Dry (t)	
Sowing dates											
1st June	29 35	343 19	23 69	32 86	15 64	8 81	367 40	213 85	1 62	0 97	4 60
1st July	27 49	250 85	20 59	32 42	11 27	5 23	290 15	180 77	1 29	0 81	2 02
1st Sept	20 84	158 24	16 33	21 39	5 47	2 02	121 89	51 09	0 53	0 22	1 22
1st Oct	13 58	97 39	11 18	13 82	3 15	1 21	50 21	24 71	0 21	0 10	1 10
S Em	0 465	33 35	0 964	1 405	3 445	0 294	25 26	12 67	0 114	0 058	
C.D at 5%	1 611	115 43	3 337	4 864	1 542	1 017	87 43	43 86	0 344	0 20	
Spacing											
15×15 cm	22 40	197 22	16 95	23 57	8 404	3 95	282 62	166 08	1 253	0 758	
30×15 cm	22 00	201 59	18 60	24 41	8 088	3 74	205 68	110 71	0 909	0 502	
30×30 cm	24 04	238 49	11 29	27 40	10 170	5 26	133 94	76 03	0 590	0 336	
S Em	0 617	21 415	0 522	0 902	0 235	0 115	7 91	5 82	0 036	0 028	
C d at 5%	-	-	-	-	0 705	0 345	23 74	17 47	0 108	0 084	

Different dates of sowing were found to significantly influence the growth of the plant. Sowing on 1st June recorded the maximum plant height (29 35 cm), plant spread (343 19 cm²), number of branches (23 69), number of leaves (32 86) and leaf area (134.84 cm²) which was significantly higher compared to other sowings. There was a decreasing trend observed in the growth parameters as the sowing was delayed from 1st June to 1st October.

However, none of the spacing levels and their interaction with different sowing dates produced significant effects on growth parameters.

The data on the yield parameters clearly showed that the crop sown on 1st

June recorded highest fresh and dry herbage yield per plant (15.6 g and 8.81 g), per plot (367.40 g and 214.85 g), per hectare (1.62 t and 0.97 t) and andrographolide content (4.6%), which was significantly higher than later sowings.

Among the different spacings, a spacing of 30 × 30 cm recorded the maximum fresh and dry herbage yield per plant (10.17 g and 5.26 g), while the 15 × 15 cm spacing resulted in the highest fresh and dry herbage yield per plot (282.63 g and 166.08 g) and per hectare (1.25 t and 0.75 t).

The interactions of 1st June sowing and 30 × 30 cm spacing, recorded highest fresh and dry herbage yield per plant (17.8 g and 10.50 g) while, the interaction of 1st June sowing with 15 × 15 cm spacing was responsible for highest fresh and dry herbage yield per plot (473.05 g and 291.37 g) and per hectare (2.10 t and 1.42 t).

DISCUSSION

The increase in the growth of the plant sown on 1st June might be attributed to the favourable weather conditions prevailing during the crop growth which might have influenced the plant to put on the maximum growth. Similar results were observed by Bhati (1988), Ramesh *et al.*, (1989) and Sudheendra (1993).

The results on the yield data also reveal increasing trend in the yield when the sowing of the crop was taken up on 1st June. This trend might be attributed to the increased plant height, plant spread, greater number of branches and leaves which in turn might have contributed to higher yield of herbage produced by the plants due to favourable weather conditions that prevailed during the crop growth period of 1st June sown plant. These results are in congruity with the findings of Maheswari *et al.* (1989) and Singh and Randhawa (1990). The sowing on 1st June also significantly influenced the production of andrographolide. Roy and Dutta (1987) have similarly reported the difference in the andrographolide content in the plants collected from different parts of Asia including India and according to them the environment and genotype influence on the production of this active principle.

The widely spaced plants recorded the maximum fresh and dry herbage yield per plant. This might be due to effective utilization of light, moisture and nutrients by the plants whereas, the close spaced plants recorded the maximum fresh and dry herbage yield per plot and per hectare which was due to the fact that the number of plants per unit area were more. These results conform the findings of Vadeil *et al.* (1980), Randhwawa and Gill (1982), Hedge (1985) and Gangadharappa *et al.* (1990).

From the present study, it can be concluded that in order to obtain the maximum growth and herbage yield, the crop is to be planted during 1st week of June following 15 × 15 cm spacing.

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Section 4

INTERCROPPING MODELS WITH NTFP SPECIES

Sustainable High Production: Soil and Environmental Protection with High Income—A Personal Experience in Agro-Forestry

Surinder Singh Hara

This is a success story of an Agro-forestry Horticulture Farm now engaged in high levels of sustainable production, soil and environment protection and high incomes. The soils of this farm are extremely poor in fertility and texture with a higher water table especially during monsoons when 50% of the area is water logged. USA Bureau of Soil Reclamation Standards would classify these as Grade III—soils of marginal productivity.

Every acre of this 110 acre farm is now producing timber, agricultural crops and fruits. The income generated now exceeds the income from commonly grown crops/crop rotations of Haryana, Punjab and Western U.P.—a region famous for its high agricultural productivity, the Green Revolution Area.

It is also a story of hard work, long term planning, high investment, innovations, skills, technology, management and initial failures and frustrations. Innovations and improvements continue every passing year.

There is an Israeli saying that, “No land is useless, but there are a lot of lands for which an economic use has not been identified.” This saying justly applies to this farm and is being addressed with increasing levels of success.

Crops, fruits and other agricultural enterprises were selected that were considered suitable for each field. Poplars were introduced in 1982 and found to grow successfully. It took every innovative skill, technology and management to grow them optimally. Poplars on this farm now grow better than on heavier, rich soils, 2 km away. The farm house building complex was built on 8 acres of a badly eroded hill. This 70 ft high hill now has been terraced. Drip sprinkler irrigation systems were installed. Every square metre of this hill is now growing fruits, flowers, vegetables, grapes and timber trees strategically placed to keep the buildings cool and the road shady, an example in land use and conservation.

A 2.5 acre area was permanently waterlogged. Half of this field was dug 5 feet deep and the earth put on the other half. Now there is a 1.25 acres fish pond stocked with 25,000 fingerlings of six different varieties of carp. Technology from Israel will now be copied to get higher carp fish-yield. The remaining 1.25

acres is for growing vegetables and flowers. All around Silver Oak is planted at 8 ft intervals. Silver oak was identified as a fast growing tree of high quality timber suitable for this field. Investment on these 2.5 acres far exceeded the price of land, but it is now generating a good income while the soil and ecology has also improved.

This farm is now worked around an idea that plant growth is influenced by three essentials: water, plant nutrition and sunlight. Fortunately, all 365 days of the year are plant growing days. Water is plentiful, so is plant nutrition in the form of poultry/dairy manures and chemical fertilizers (N.P.K. and micro-nutrients). Sunlight, though plentiful, becomes the limiting essential. Sunlight is now being optimally used in a very innovative way.

Location: The farm is parallelly located 6 km from the northern Haryana twin industrial cities of Yamuna Nagar and Jagadhri, 100 km from Dehra Dun, 105 km from Chandigarh. The Himalayan mountains are 40 km, N.E.

Soil: The farm is sandwiched between the Yamuna River and the Western Yamuna Canal. The entire area was at one time the Yamuna River bed. Soil is shallow, sandy-loam underlain with coarse sand, 6 inches to a few feet in depth. The underground water table is high, causing water logging on 50% of the area, during the monsoon. However due to underlain sand, the area is well drained for the rest of the year, pH ranges from 7 to 8.5. The topography is undulating from 3 to 5 feet.

Climate: The area has three main seasons: i) The hot and dry season from April through June with temperatures ranging from 40 to 45°C during the day dropping to 20 to 30°C during the night. ii) The hot and humid season runs from July through October, when maximum day temperatures range from 25 to 40°C with high humidity caused by the monsoon rains, 80% of which falls then. iii) The cool season runs from November to March. Day temperature ranges from 8 to 20°C going to 30°C in March. The minimum temperature is 2° to 5°C. Annual rainfall is 75 to 100 cm, 10-20% falling in November through March.

History. The land was reclaimed from scrub jungle during the forties and brought under rainfed-subsistence farming during the fifties. The entire region was undeveloped: dirty roads, no electricity or telephones. Farm inputs were difficult to procure, fertilizers uneconomical to use, marketing was very poor. Modern farming was started 25 years ago. Farm practices and crop selections were improved upon each year. Peach, plum, guava, planted in the early 60's, on 50 acres were found unsuitable and were pulled out to be replaced by mango, litchi and pear, found to be more suitable as were some other crops.

Agro-forestry: In the early 60's, *Eucalyptus* was introduced as were some other commonly grown trees, e.g., Shisham, Jamoa, Mulberry, Acacia Kiker, Cotton

Silk Tree (Symbal), Sris, etc., and were planted on the farm boundary and in between, mainly to serve as wind breaks. All these (except some *Eucalyptus*), were discarded during the 80's for their slow growth and poor marketability and were replaced by Poplars which showed a promising performance. A lot more remained to be done.

Poplars: Poplars were introduced in 1982 and the area under Poplars expands to cover 100 acres now. Poplars were planted in various configurations and densities as then recommended by the Forestry Experts and by WIMCO Ltd who introduced commercial poplar plantations in 1980-81. The main configurations were 5m × 5m, 5m × 4m, 4m × 4m. Poplar densities varied from 80 to 250 poplars per acre. Subsequent experiences revealed that these configurations were not conducive to optimum growth, neither for poplars nor for crops and fruit plants to be grown under them. Poplars planted closer together in both directions created a thick canopy at the top, that severely retarded fruit plant growth and crops underneath as they did not get enough sunlight. It also retarded the poplar growth as the lower branches did not get enough sunlight and affected photosynthesis rate and wood production. The poplar trees also grew taller in search of sunlight but remained spindly. Although the total biomass produced was impressive, 15 tonnes per acre per year, the price realized in the market was low due to small girth.

The Appendix-1 depicts the results of poplar yields on 5 year to 10 year rotations with poplar densities, from 70 to 200 trees per acre. The different intercrops grown, their yields and fruit trees with their planting distances, performances, etc., are also provided. Total poplar biomass produced and its break up by different sizes (above 24" dia., 18" - 24" dia., 10" - 18" dia., below 10" dia., and roots) as required/accepted in local market are also given. Total biomass produced per acre per year is also analysed.

It is difficult to workout income, as a market price of poplars have been increasing by 10% to 20% each year. In 1988, market price of poplars above 18" dia. was Rs. 82/ctl. and 10" - 18" dia. — Rs. 38/ctl. In 1994, in the local market, poplars of 24" and above girth are approximately Rs. 210/ctl., between 18" - 24" dia. — Rs. 135/ctl., for 10" - 18" dia. — Rs. 105/ctl. and below 10" dia. — Rs. 35/ctl., the roots at Rs. 30/ctl.

The new poplar plantations now have a longer distance between the rows and less distance between plant to plant. Configurations now being tried are 24' × 6', 36' × 6', 36' × 8' and 36' × 12'. Rows are north to south and alternate with rows of fruit (mango, litchi, pear), trees also north to south. The sun rising in the east and setting in the west, gives equal amount of sunshine to all trees. Sunshine also reaches the lower branches, thus increasing photosynthesis. Already the growth of the poplars and fruit trees is spectacular. The total timber production per acre per year, is expected to be higher and of larger girth.

Income is expected to be higher compared to the earlier square configuration with the same number of poplars, growing per acre. Thinning of poplars is planned twice after 4 years and 8 years, from 300 plants per acre to 80 plants per acre. Experience shows that incremental growth of poplars per tree per year is far greater after 8 years. A poplar rotation of 12 years or possibly 15-20 years is planned. The greater advantage is the excellent growth in fruit trees because they receive more sunshine. Longer distances between rows and shorter from plant to plant with the row running north to south further ensure that the poplar plantation grows uniformly with less chances of tall trees dominating less vigorously growing trees.

Poplar Nursery: After very unpleasant and expensive experiences, it was discovered that selection and propagation of poplar variety and its right clone is very important. Earlier poplar plantations grew so unevenly that the right quality size harvestable poplars were hardly 50%. Some poplar trees grew faster than others mainly due to their genetic quality and greater suitability to the farm soil. Such trees dominated other trees that remained of smaller size, often only spindly saplings. This reduced the overall timber yield. In later years, the cuttings were taken from only those 1% of trees that were the best in growth and shape. The nursery field is very well prepared and optimum amounts of manure mixed in-thoroughly with suitable soil-insecticides. Six-inch long cuttings were planted 1 foot apart and 2 feet row to row, in February. Frequent irrigation, weeding, also pruning (to allow only one main stem to grow) was carried out at nursery stage besides protection from insect pests. By December, the nursery plants were about 15-20 feet long. Transplanting in the fields was carried out in beginning of February. Four feet deep holes were dug by an auger and filled with 50% top soil and 50% well decomposed farmyard manure, along with 50 grams of superphosphate and a few grams of soil insecticide. The soil should not be compacted too tightly and the poplar plantation should be irrigated regularly.

Pruning: Pruning is very essential for proper tree growth, to maximize the marketable wood of bigger girths and keeping it knot free. In earlier planting, 1/3 of the tree height from the bottom was pruned, i.e., 30 feet high trees pruned 10 feet from the ground, 60 feet high trees pruned 20 feet from the ground. This method was not found satisfactory—neither for total growth nor for wood quality. The practical experience gained suggests that pruning be confined to keeping only one leader branch at the top and all those branches should be pruned that grow more than 10" in diameter. If these larger branches are not pruned, they not only rob the main tree of wood but cause knots that reduces the marketability of the main tree bole. Pruned this way, the tree reaches 100 feet height in 8-10 years, is knot free and its marketable wood is 90% to 95% of the total biomass,—remaining 5-10% sold as fuel.

Manuring: No recommendations on manuring of timber trees were available. The general opinion was that leaves and other organic material disintegrating generate enough plant nutrient for the forest trees. It was also opined that tree fibre needs its own time to develop and cannot be hastened. The experience on my farm soil is different. Trees, like crops, respond to manuring and irrigation very favourably with 100 kg murate potash, 200 kg superphosphate, 300 kg urea, 20 kg zinc and some macronutrients and partly its equivalent in poultry/dairy manures are applied per acre per year with excellent results. Manures and fertilizers are applied 5 times a year to prevent leaching as soil of the farm is sandy loam underlain with sand and get water-logged each monsoon. The farm yields of poplars, intercrops and fruits are tabulated in Appendix-1. It is planned to double this quantity of manure/fertilizer applications. The rationale is that for wheat and paddy rotation in northern India, to expect 2 tonnes of wheat and 3 tonnes of paddy per acre, the generally recommended fertilizers are 100 kg potash, 200 kg superphosphate, 300 kg urea, 20 kg zinc and macronutrients with slight modification for different soils. This quantity of fertilizer yields 5 tonnes grains and an equivalent wheat/paddy straw—a total of 10 tonnes of biomass per acre per year. The farm produces more than double this quantity per acre per year in timber, crops and fruits. To keep soils fertile and in sustainable production, one must return to the soil, the same quantity, if not more, of plant nutrients as taken away by crops. Soil is like a bank and should have a little more than what is withdrawn to keep the account healthy.¹

Soil erosion control: The farm topography is undulating. Large scale land levelling was not possible as the shallow top soil is underlain with coarse sand. Fields were levelled in small sizes for irrigation. The field size varies from one fifth of an acre to five acres. Each field bunded to stop erosion and prevent accumulation of water (rain or irrigation) in low lying areas. Small tractor with rotavators were bought to cultivate these small fields and planting of intercrops in them.

Intercropping. Intercropping is important for soil erosion control, improving soil organic matter content and for generating more income. During the first 2 years of the poplar plantation, sugarcane was found to be the best. Sugarcane and poplars complement, require the same farm-inputs (manuring, irrigation, etc.) at the same time and do not interfere with each other's growth during the first year, so long there is enough manure and water for both. During the second year, however, sugarcane suffers due to the poplar tree shade. Average yields of

¹ In Hawaii some of the sugarcane plantation area has only 0.6m of soil underlain with corals. Yet this area has been producing one of the highest per acre sugarcane yields in the world, consistently year after year for over 100 years now. It is on the strength of manures and fertilizers applied.

30 tonnes of sugarcane in the first year and 15 tonnes—the second year, have been consistently obtained. The sugarcane crop was harvested in November next year and wheat planted. The leaves of the poplars start falling in November and by mid December 90% have fallen. Leaves come back in the beginning of April and full canopy formed by the end of April, thus giving 100 to 120 days of clear sunshine to the ground. Any economically suitable crop of that duration is possible to grow. Intercrops tried so far and found suitable are: wheat, oats, barley, potatoes, mustard, legumes, lentils, chickpeas, vegetables and flowers.

The importance of intercropping lies in the fact that the soil is kept fertile by manuring/fertilizing and the residual is utilized by poplars as it starts growing in the spring season. It is generally believed that for any crop, the quantity of roots developed is equivalent to the growth of the plant organic matter above the ground. Even if the total organic matter of the crop above the ground is removed (as in forages) there is equivalent organic matter left in the soil to disintegrate to act as plant food for the next crop or poplar trees. Efforts continue to find suitable intercrops that can be grown all year, i.e., one that can grow under the shade of poplars during the 8 months of summer. Turmeric has so far been identified and its seed is being multiplied for large scale plantings.

Experience shows that poplar trees need a minimum 200 sq ft area to grow properly. The main avenues on the farm are, therefore, kept 22 ft wide and poplars planted each side 9 feet apart, giving 198 sq ft. for each poplar to grow optimally. On the boundary of the farm, poplars are planted 6 feet apart and cover the entire boundary. On the boundary, in suitable directions, teak has also been planted. The idea is to utilize every square metre of the farm for growing something of economic value, and yet not let the shade interfere with whatever is growing in the fields. The choice depends on the sunshine available as water and plant nutrients can be given in any quantity.

Irrigation. Irrigation is by the flood method from 11 tubewells, Sprinkler and drip irrigation is being tried.

Economics. As mentioned earlier the income from the farm exceeds the income from the commonly grown crops of northern India. In fact the forestry income alone exceeds the income from the conventional crops grown now. Yet the price of poplar wood, sawn—to size and F O R. Jagadhri Railway Station is quite competitive in price to any sawn-to-size wood F O R. in the developed countries of the world, including timber rich Canada.

Future Planning. Efforts continue to identify intercrops of higher economic value. Among the crops and agricultural enterprises being considered are floriculture and raising of poultry broilers when suitable fencing can be created for protection.

APPENDIX - 1

Poplars Grown in 5.5 yr. Rotation

Area	5.5 Acres		
Planted	Jan 1983	Total no of trees planted	710
Harvested	July 1988	Total no of trees harvested	669

Poplars planting distance	18' x 36' Alternate Rows
	.36' x 36' Alternate Rows

Total Quantity of Poplar Biomass Harvested		4221 Qtl [422 1 Tonnes]	
Diameter	above 18"	10" - 18"	under 10"
Quantity	3303 35 Qtl	717 80 Qtl	200 00 Qtl
Percentage Size	78 %	17 %	5 %

Poplar Biomass per acre per year 139 5 Qtl

Inter Cropping

Sugar Cane	Plant Crop	. 275 Qtl/acre [excluding sugarcane tops]
	Ratoon	: 125 Qtl/acre
Wheat	4 Crops total	54 Qtl/acre
Wheat	Straw (Bhusa)	. 54 Qtl/acre
Total Biomass in 5.5 years		508 Qtl/acre

Mango Plant distance **18' × 36'** **471 plants [Planted in 1983]**

Litchi Plant distance **36' × 36'** **235 plants [Planted in 1983]**

Intercrop Biomass per acre/year 92 4 Qtl
[excluding mangoes and litchis]

Total Biomass per acre/year 231 9 Qtl [23 2 Tonnes]

Note: The price of poplar logs (above 60 cm circumference) has increased from Rs 82/Quintal in 1988 to Rs 300/Quintal in May, 1995

The net income can be calculated for each year at the following rates.

1988	Rs 82/Q	1989	Rs 95/Q	1990	Rs. 105/Q
1991	Rs 125/Q	1992	Rs 150/Q	1993	Rs. 157/Q
1994	Rs 195/Q	1995	Rs 210 to Rs 300/Q	in May 1995	

Poplars Grown in 7 Year Rotation

Area	2.5 Acres		
Planted	Jan 1983	Total no of trees planted	645
Harvested	Feb 1990	Total no of trees harvested	526

Poplars planting distance . 15' x 15'

Total Quantity of Poplar Biomass harvested 2773 Qtl [277.3 Tonnes]			
Diameter	above 18"	10" - 18"	under 10"
Quantity	2238.00 Qtl	3820.00 Qtl	152 Qtl
Percentage Size	80.72 %	13.80 %	5.48 %
Total Poplar Biomass 2.5 acre/7 years		2773.00 Qtl	

Total Poplar Biomass per acre per year . 158.59 Qtl

Intercropping

Sugar Cane		302 Qtl/acre]	
	Ratoon	130 Qtl/acre]	432.00 Qtl
Wheat	5 Crops total	11.5 Qtl/acre]	57.50 Qtl
Wheat	Straw (bhusa)	11.5 Qtl/acre]	57.50 Qtl
Total Intercrop Biomass in 7 years			<u>547.00 Qtl</u>

Intercrop Biomass per acre/year 78.14 Qtl

Total Biomass produced per acre/year 236.64 Quintal [23.65 tonnes]

Poplars Grown in 7.5 Year Rotation

Area	8 Acres		
Planted	· Jan 1983	Number of trees planted	910
Harvested	· Sept 1990	Number of trees harvested	871

Poplars plant distance 36" × 12" + Border

Total Quantity of Poplar Biomass harvested	7091 Qtl [709.1 Tonnes]		
Diameter	above 18"	10" - 18"	under 10"
Quantity	6348.5 Qtl	522 Qtl	221 Qtl
Percentage Size	89.52 %	7.36 %	3.12 %

Poplar Biomass per acre per year 118.19 Qtl [11.82 Tonnes]

Inter cropping

Sugarcane one year crop on 8 acres 450 Qtl
[excluding tops]

Wheat 5 crops grain yield 55 Qtl

Wheat straw 55 Qtl 880 Qtl [in 8 years]
[11 Qtl per acre average]

Total Intercrop Biomass in 8 acres/7.5 years 1330 Quintal

Mangoes 270 trees 4 & 1/2 years old in 1983 Fruit trees continue to
12 years old at poplar harvest grow but slightly
below normal growth

Mango planting distance · 36' × 36'

Intercrop Biomass per acre/year · 22.16 Qtl

Total Biomass per acre/year 130.35 Qtl [13 Tonnes]
[Excluding sugarcane tops and mango tree growth and fruits]

Poplars Grown in 8 Year Rotation

Area	6 Acres		
Planted	Jan 1984	Number of trees planted	960
Harvested	Jan 1992	Number of trees harvested	854

Poplar Planting Distance 16' 4" x 16' 4" [5m x 5m]

Total Quantity of Poplar Biomass harvested : 6207.75 Qtl

[In 48 acre years]

Diameter	above 24"	18" - 24"	10" - 18"	under 10"	Roots
Quantity	3910 40 Qtl.	976 60 Qtl	686 90 Qtl	321 05 Qtl	312 80 Qtl
% Size	63 %	15 73 %	11 06 %	5 17 %	5 03 %

Poplar Biomass per acre per year 129 32 Qtl

Intercropping	Biomass
Sugarcane [Plant Crop]	275 Qtl/acre [excl sugarcane tops]
Ratoon	80 Qtl/acre
Wheat 6 crops	81 Qtl/acre
[yield varied from 11 Qtl to 17 Qtl/acre]	

Wheat straw 81 Qtl/acre

Total Intercrop Biomass in 8 years 517 Qtl

Intercrop Biomass per acre/year 63.38 Qtl

Total Biomass per acre/year 192 70 Qtl [19 27 Tons]

Poplars Grown in 8 Year Rotation

Area	· 7 Acres	Number of trees planted	470
Planted	· Feb 1983	Number of trees died	· 81
Harvested	Feb 1991	Number of trees harvested	389

Poplar planting distance : 18' × 36'

Total Quantity of Poplar Biomass harvested 3650 Qtl [365 Tonnes]

Diameter	above 18"	10" - 18"	under 10"
Quantity	3210 Qtl	264 Qtl	176 Qtl
Percentage Size	87.94 %	7.24 %	4.82 %

Poplar Biomass per acre per year 65.17 Qtl

Intercropping

Pears	940 Trees	[In 1983, pears were 5 yrs old At poplar harvest, pears 13 yrs old]
Pear planting distance		36' × 9'
Sugarcane 1 year crop on 7 acres [excluding sugar cane tops]		750 Qtl
Wheat 3 crops		8 Qtl /acre
Wheat straw		8 Qtl /acre

Average Biomass Wheat & Wheat straw per year/7 acres 112 Qtls

Average Biomass Wheat & Wheat straw 3 years/7 acres 336 Qtls

Forages [Barseem and Oats] 3 crops
[four cuttings each year]

Average Biomass per acre/year
[dry matter 25 Qtls] 100 Qtls

Intercrop Biomass per acre/year 28.76 Qtls
[excluding pears and sugar cane
tops]

Total Biomass per acre/year 93.94 Qtls [9.4 Tons]

Note Although pear trees had normal growth but fruiting in the lower half of pear trees suffered. Fruiting was approximately 10 tonnes per acre. After harvesting poplar trees, the pear fruit yield averaged 19 tonnes per acre.

Poplars Grown in 10 Year Rotation

Area	7 Acres	Number of trees planted	1425
Planted	Feb 1983	Number of trees died	388
Harvested	Feb 1993	Number of trees harvested	1037

Poplars Planting Distance 15' × 15' + Border

Total Quantity of Poplar Biomass harvested 11066 Qtl

Diameter	above 24"	18" - 24"	10" - 18"	under 10"	Roots
Quantity	7676 Qtl	1349 Qtl	819 Qtl	657 Qtl	565 Qtl.
% Size	69.36 %	12.19 %	7.4 %	5.95 %	5.1 %

Poplar Biomass per acre per year . 158 Qtl

Intercropping Biomass

1 Crop Potatoes [Tuber only] 64 Qtl

Sugarcane Plant Crop 250 Qtl
[excluding tops]

Ratoon 50 Qtl

6 Crops Wheat 72 Qtl

Wheat Straw [Bhusa] 72 Qtl

[yield varied from 10 Qtl to 14 Qtl /acre]

Total Intercrop Biomass per acre/10 508 Qtl
year

Intercrop Biomass per acre/year 50.8 Qtl

Total Biomass per acre/year 208.8 Qtl [20.9 Tons]

Data for harvestings of poplar done in 1994-95 and May, 1995 can be supplied on request

Prospects and Models for Raising Aromatic Plants in Different Forestry Programmes for Economic Uplift

M.P. Shiva and Rubab Jaffer

INTRODUCTION

Generally the farmers have been planting *Eucalyptus* hybrid on large scale throughout the country with greater fillip during the last decade in various forestry programmes. Therefore, studies were undertaken on the possibilities of raising plantations of *Eucalyptus citriodora* and *Cinnamomum camphora* particularly in North India and Karnataka for obtaining higher returns from essential oil in addition to fuel and wood for poles

With these considerations four models have been designed for growing *E. citriodora* or *Cinnamomum camphora* as major species in block planting under farm forestry or border planting along the bunds of agricultural fields in agroforestry or intercropping with aromatic grasses under social forestry programme on vacant or wastelands at different spacings.

MODELS FOR PLANTING

Four models have been proposed here for raising aromatic plants in different forestry programmes for increasing productivity and economic benefits

Model-1

Eucalyptus citriodora or *Cinnamomum camphora* at 1 m × 1 m or 2 m × 2 m under farm-forestry programme (Fig 1)

This model gives the design of block planting under farm forestry programme. This can be adopted by the land owners of different sector after utilizing their land for growing agricultural crops

The details of each species are given below

(a) *Eucalyptus citriodora*

E. citriodora may be raised at 1 m × 1 m or 2 m × 2 m spacing and harvested initially by coppicing after four years. About 5,000 poles can be obtained

X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X

Fig. 1: Model-1 for planting *Eucalyptus citriodora* or *Cinnamomum camphora* at 1 m × 1 m or at 2 m × 2 m spacing under farm forestry programme

after deducting 50% losses from plantation raised at 1 m × 1 m which may be easily sold at the rate of Rs. 15/- per pole. Thus about Rs. 75,000 may be obtainable from one hectare of land after 4 years. In case plantations are raised at 2m × 2m spacing, 2,500 trees will yield about 2000 poles and fetch Rs 30,000 or more depending upon the quality of poles. The leaves will also be available for the recovery of essential oil which will yield about 250 litres of oil under irrigated land (Singh, 1977) which will fetch about Rs 25,000 or 20,000 respectively at the minimum rate of Rs. 100/- per kg.

Thus the gross income of about Rs 95,000 can be obtained after 4 years, out of which Rs. 11,000 may be deducted towards the cost of plantation per ha and nearly Rs. 25,000 may be deducted towards the cost of the distillation unit of 200 kg capacity. Thus a net profit of Rs 59,000 is obtainable at the end of four years. Later on, one leader shoot, out of the coppiced shoots may be allowed to grow for further four years and the harvesting of leaves may be continued annually from the other coppiced shoots. It is not well known whether in subsequent years the total production of oil would be lower or higher. However, after reducing 25% of production, it may be assumed that 175 kg oil as against 250 kg should be obtainable from irrigated plantation which will fetch, about Rs 17,500 annually. At the end of eight years after accounting for 50% mortality, the poles will also fetch about Rs.1,00,000 from the sale of about 5000 poles at the rate of Rs 20/- per pole, as the poles are likely to be of better girth in the next coppiced crop which is generally vigorous. Similarly poles from second

coppiced crop at the end of twelve years will be obtainable. But this time the poles may be smaller and may fetch Rs. 10/- per pole and Rs.50,000 may be expected from the sale of about 5,000 poles. In case of irrigated plantation it may be possible to obtain poles from third coppiced crop also at the end of sixteen years when the plantation will have to be renewed. The poles may fetch about Rs 10/- per pole this time also with a total return of Rs 50,000. These assessments have been based on the experiences gained by the farmers in Haryana. A break up of the investments, expenditure and the returns roughly assessed up to sixteen years is given below

(i) Investment for raising one hectare plantation during four years including expenditure of Rs.2,000 on nursery, Rs 9,000 on plantation including fertilizer application, hoeing and irrigation inclusive of labour, maintenance upto 4 years and rent of land and interest on capital, etc	Rs 11,000
(ii) Cost of maintenance and fertilizers @ Rs 1000/ha/annum for further 12 years	Rs 12,000
(iii) Investment and expenditure on fabrication of distillation unit, etc , for recovery of essential oil	Rs. 25,000
(iv) Total investment	Rs. 48,000

Breakup of approximate annual return after the end of 16th year of plantation:

(v) (a) Approximate returns from the sale of 250 kg *E. citriodora* oil (at the minimum rate of Rs. 100/-kg) at the end of four years. Rs 25,000

(b) Approximate annual returns from oil from 12 harvestings at the end of sixteen years @ Rs. 17,500/- for 175 litres of essential oil per year @ Rs 100/ kg Rs. 2,10,000

(c) Approximate returns from the sale of 5,000 poles at the end of four years @ Rs. 15/- per pole Rs. 75,000

(d) Approximate returns from the sale of 5000 poles at the end of eight years @ Rs. 20/- per pole Rs 1,00,000

(e) Approximate returns from the sale of 5000 poles at the end of twelve years. @ Rs 10/ per pole Rs. 50,000

(f) Approximate returns from the sale of 5000 poles at the end of sixteen years @ Rs 10/per pole Rs. 50,000

Grand total of expected returns at the end of sixteen years from essential oil and wood for poles. Rs 5,10,000

–Less total investment and expenditure Rs 48,000

–Net gains at the end of sixteen years Rs 4,62,000

–Approximate annual returns Rs. 28,875

The above returns do not include the cost of fuel-wood which is obtainable each year from harvesting of the crops which is utilized by local people. Thus return of about Rs.29,000 from one hectare of land per year is quite encouraging as returns from agriculture crops per hectare per year is much less and may be only one third as compared to the above farm-forestry practice. Since the above model is mainly for obtaining essential oil from coppiced crops to be harvested at the proposed rotation, the spacing has been proposed at 1 m $\times$ 1 m. If the planters are interested primarily in the production of wood then they may raise the plantation at 2 m $\times$ 2 m spacing. In that case only 2,500 trees will be raised and harvesting of the crop would be done at the rotation of eight years, when the leaves may also be distilled for essential oil.

(b) *Cinnamomum camphora*

Plantations are raised in localities suited to it, the same may be grown for obtaining natural camphor and camphor oil. 10,000 plants can be planted per hectare at a spacing of 1 m $\times$ 1 m or 2,500 plants at 2 m $\times$ 2 m (Fig. 1). Studies have also revealed that camphor trees can be pollarded after 2 years of plantation and good crop of leaves is obtainable twice a year.

It is therefore, advocated that camphor plantation may be raised mainly for recovery of essential oil. It has been estimated that the leaves from pollarded crop yield camphor oil upto 4% which contains about 80% of natural camphor (Bhandari, 1987), as against 2% from old standing trees with decreased production and higher expenditure in harvesting of leaves. The expected sale price of camphor oil is Rs 80/- per kg. De camphor sulphonic acid can be manufactured from natural camphor which fetches about Rs 350/-per kg. It is expected that much better returns would be obtainable as compared to agricultural crops raised in the same area by production of natural camphor and camphor oil which is in good demand in India.

Model-2

Eucalyptus citriodora or *Cinnamomum camphora* along the bunds at 1 m or 2 m spacing under agroforestry programme (Fig. 2).

Agroforestry deals with the raising forestry species interspread with the traditional agricultural crops on the agricultural land. The objective of this new concept of forestry is two dimensional, i.e., to increase the forest cover to maintain ecosystem and to produce basic forest produce like fuel, fodder and small timber, reducing the pressure on traditional forest. This has a direct interaction with the agriculture crop and trees as soil nutrient and fertilizer given to agriculture crop are also utilised by the tree crops. There is an added advantage of growing trees that they become beneficial by way of reducing wind effect and functioning as shelter belts to the crop and also protecting the crop to some

can be grown easily along the boundaries of agricultural fields.

Model-3 & 4

These models are proposed for interplanting of essential oil yielding grasses with *Eucalyptus citriodora* or *Cinnamomum camphora* at $2\text{ m} \times 2\text{ m}$ or $3\text{ m} \times 2\text{ m}$ spacing under social forestry programme (Figs. 3 and 4)

Under various afforestation programmes like social and agroforestry, efforts are being made to raise plantation for meeting the basic needs of fuel and fodder. A model proposed here is basically meant for providing wood for fuel, poles and paper pulp while obtaining additional profits simultaneously from the utilisation of the tree leaves and essential oil yielding grasses raised as an under storey.

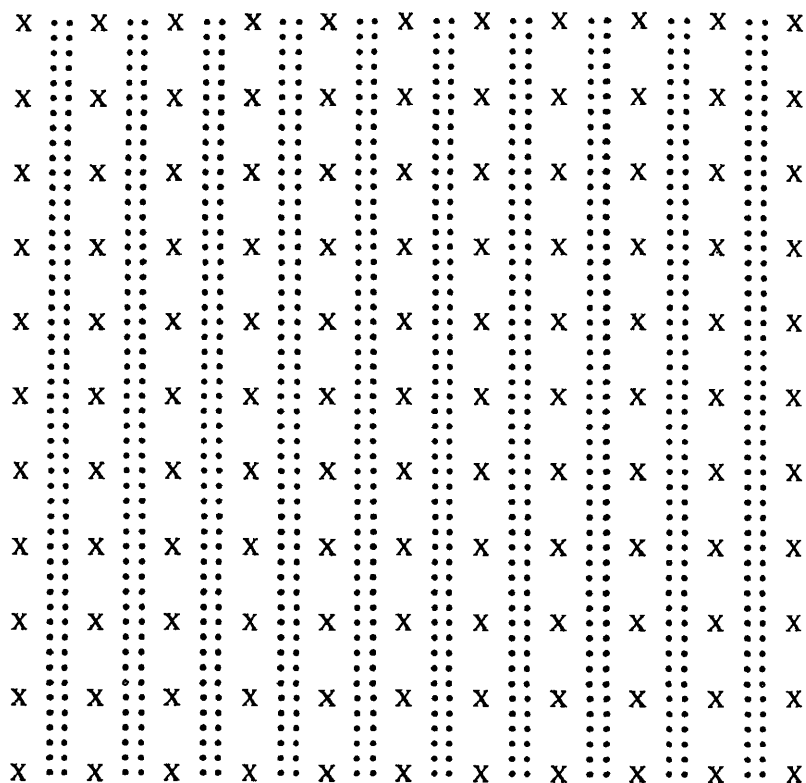


Fig. 3: Model-3 for interplanting of essential oil yielding grasses with *Eucalyptus citriodora* or *Cinnamomum camphora* at $2\text{ m} \times 2\text{ m}$ spacing under social forestry programme
 X = *Eucalyptus citriodora* or *Cinnamomum camphora*

● = Aromatic grasses

Model for planting with *Eucalyptus citriodora* (Figs. 3 and 4)

This model advocates to plant *E citriodora* for the above purpose at 2 m × 2 m or 3 m × 2 m spacing with 2,500 or 1,666 trees respectively (Figs. 3 and 4) The interspace between the trees would be lying vacant if the plantation would be harvested at normal rotation of about six to eight years for production of wood Therefore, this model suggests to utilize the vacant interspace with the interplanting of essential oil yielding grasses like lemon grass, citronella grass or palmarosa grass.

It has been assessed that if only *Eucalyptus* hybrid is raised at 2 × 2 m spacing or 2.5 × 2.5 m, 3 × 1.5 m, 4 × 2 m or 6 × 1 m with 2,500, 1,600, 2,222, 1,250 or 1,666 trees respectively per hectare, the returns from *Eucalyptus* hybrid ranges from Rs.8,702 to 32,371 in Punjab, Haryana and U P at the end of eight to ten years. (Mathur *et al* , 1984) But in this case, although the essential oil is obtainable which has been classed as an industrial oil, the same does not have economic feasibility as the cost of pinenes obtainable from turpentine is much lower than the cost of pinenes obtainable from *Eucalyptus* hybrid leaves (Shiva *et al.*, 1984, Mehra & Shiva, 1988). Therefore, it has been proposed that *E citriodora* may be planted at the spacing of 2 m × 2 m or 3 m × 2 m and intercropping this tree species with essential oil yielding grasses.

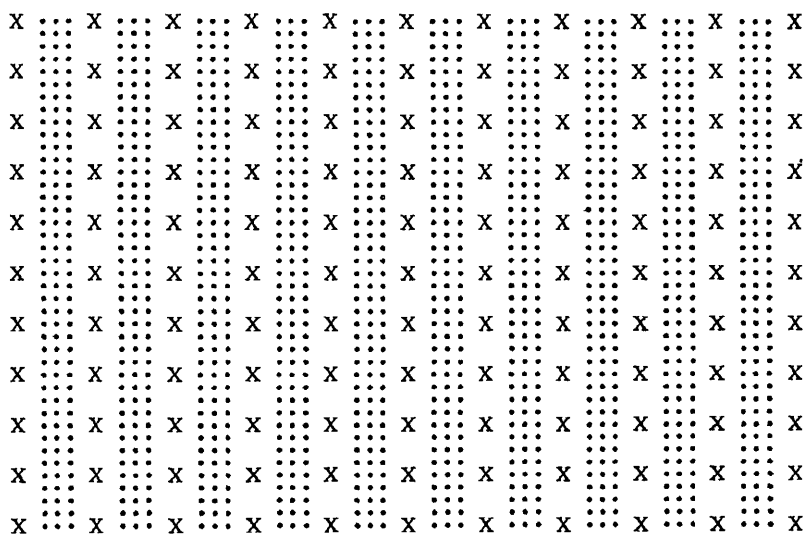


Fig. 4: Model for interplanting of essential oil yielding grasses with *Eucalyptus citriodora* or *Cinnamomum camphora* at 3 m × 2 m spacing under social forestry programme

X = *Eucalyptus citriodora* or *Cinnamomum camphora*, ● = Aromatic grasses

In this case the rotation of working may be adopted (Fig. 1), which is likely to fetch encouraging profits.

In addition to utilization of both wood/poles and leaves, the vacant space between the trees can be profitably utilized for planting two rows of essential oil yielding grasses, leaving 75 cm spacing on either sides. The space between the rows of the grass culms may be 50 cm while the distance between the grass culms in the rows may be half a metre or one metre.

If the plantation is raised at 3 m × 2 m spacing (Fig. 4) it is advisable to plant three rows of aromatic grasses at half metre spacing from row to row and culm to culm, in the middle of three metre space of *E. citriodora* trees leaving one metre space on either sides of the grasses. This way the coppiced crop of *E. citriodora* can be maintained in a very healthy manner and good yield of essential oil can be obtained both from trees and grasses. It is expected that the returns will be higher from the yield of essential oil from grasses as compared to returns from agricultural crops.

Net profits obtainable per hectare per year from different essential oil yielding grasses is furnished below as reported about a decade ago by the Central Institute of Medicinal & Aromatic Plants, Lucknow

1 *Lemon Grass*

Production of oil per ha in I year	-25 kg
Production of oil per ha during II to VIth year per (year)	- 100 kg
Total production of oil per ha in six years	-525 kg
Returns from 525 kg oil @ Rs 100/ha per kg in 6 years	-Rs 52,500/-
Expenditure during six years	-Rs 20,000/-
Returns during six years per ha	-Rs 32,500/-
Therefore, Net profit/ha/year	-Rs. 5,916/-

2. *Citronella Grass*

Yield of oil/ha in Ist year	-162.5 kg
Yield of oil/ha in IInd year	-300 kg
Yield of oil/ha in IIIrd year	-300 kg
Yield of oil/ha in IVth year	-250 kg
Total yield of oil in 4 years	-1,012.5 kg
Total returns from sale of 4,050 kg oil in four years from four ha of land @ Rs 100 per kg	-Rs. 4,05,000/-
Expenditure during 4 year over four ha of land	-Rs 1,55,000/-
Returns during four years	-Rs 2,50,000/-
Therefore, net returns/ha/year	-Rs. 15,625/-

3 *Palmarosa Grass*

Estimated production of oil in four years.	-220 kg
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Returns from sale of 220 kg oil @ Rs.200/- per kg	-Rs. 44,000/-
Expenditure in four years	-Rs 10,000/-
Net profit per ha in four years	-Rs. 34,000/-
Net profit per ha year	-Rs 8,500/-

Model for interplanting with *Cinnamomum camphora* (Figs. 3 and 4)

In case an entrepreneur is interested only in the production of essential oil and desires to establish a cottage scale industry based on aromatic plants and if the area is suitable for *C. camphora*, he can plant it also at 2m × 2m or 3m × 2m spacing, with 2,500 or 1,666 trees respectively. Essential oil yielding grasses may be planted in between rows of camphor trees as suggested in the case of *E. citriodora* above (Fig 4). *C. camphora* pollarded tree bushes may be maintained and essential oil may be obtained both from these bushes and grasses.

Thus the plantations raised as proposed in the models, Figs. 1 and 3 will properly utilize all the available land which may not be utilizable for raising agricultural crops and it may also be emphasised here that if the above concepts are given a practical shape much higher returns as compared to agricultural crops will be obtainable. It is urged that the above suggestions may be given due consideration for improving the economic condition of the people and for increasing the national productivity of essential oils and wood simultaneously.

ACKNOWLEDGEMENT

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Section 5

ECONOMICS OF CULTIVATION OF NTFP SPECIES

Cost-benefit Analysis of *Acacia auriculiformis* and *Cassia siamea* Monoculture Plantations

P.K. Kulkarni, L.J. Bhosale and S.H. Pawar

INTRODUCTION

Today, international aid agencies and foresters all over the world have understood the importance and necessity of taking forestry outside the forests—of involving people throughout countryside in growing trees to meet their own requirements as well as to protect the land which supports them and their livestock. Since energy for rural development has become one of the more crucial issues, fuel-wood is beginning to enter the mainstream of national and international priorities. Also, stocks of underground fuels are becoming more scarce and expensive. Thus the importance of wood is increasing dramatically. This has created a place for tree growing in the area of energy production. Trees, if better managed and utilized, could prove to be an important source of energy, available in developing countries. 8% of Sweden and 15% of Finland's energy requirements are met by its generation from wood. In the United States, in 1974, more energy was generated from wood than from nuclear power (Anonymous, 1980). Trees provide the renewable source of energy.

Trees can be grown where no fuel-wood was produced before and the production can be sustained. The practice of growing high density short rotation trees per unit area, and harvesting them at ever younger ages, was first pronounced in Sycamore by Mc Alpine *et al.*, in 1966 (cf Vinayaram and Surendran, 1990). The plantations are being raised on private lands by people with the idea that it will fetch them better economic returns. The other factor which attracts them is that it requires less supervision as compared to agriculture crops. Hence it is important to make an economic analysis of different species of plantations and to find out fast growing species which can give better returns at juvenile stage. So such analysis of plantations is desirable, and has to be done frequently. An attempt has been made here in this direction with the monoculture plantations of *Acacia auriculiformis* and *Cassia siamea*.

STUDY SITE

Biomass Research Centre at Shivaji University Campus lies in South-Western region of India. It is situated between 16° 42' 5"N latitude and 74° 14' E longitude; having an altitude of 650 m above mean-sea-level. The average annual rainfall is between 1800-1900 mm. The soil type is red.

MATERIALS AND METHODS

A block of 40 × 40 m was prepared by deep ploughing the soil in the month of February, 1991. After that, pits were dug at a distance of 1 × 1 m, having size 12 × 12 × 12 cm. In the month of July, 91, nursery grown seedlings obtained from Social Forestry Department, were planted in pits along with balls of earth and small amount of cow-dung and soil mixed in (1:4) ratio. With cessation of monsoon, the plots were subjected to weeding. Totally 6 weedings were made in both plots. At the end of 1st and 2nd year, both the plots were pruned to remove the side branches, and after 2nd year of planting, the plots were thinned by making four sub-blocks. The 1st block was maintained as it is and in the next three sub-blocks, spacing of 1 × 2 m, 1 × 3 m and 2 × 2 m was maintained. The total biomass obtained was measured. During thinning, the plants were cut above 25 cm of soil level.

RESULTS AND DISCUSSION

The species selected performed well in different parts of Maharashtra and other states. *Acacia auriculiformis* is a very adaptable plant with practically no maintenance problems. It is a nitrogen-fixing species and can survive on land, very low in nitrogen and organic matter, while *Cassia siamea* is a fast growing species on good-moist sites, but is a moderately drought-hardy in dry areas, and useful for fuel and fodder (Hocking, 1993).

During the first year of growth, *Cassia siamea* showed severe wilting in the month of February. So the plot was watered during February 2nd week and March 1st week. In the next year the same plot was watered in April 1st week and 2nd week. This plot was found to be infested with Lepidopterous larvae. So 0.1% Nuvacron was sprayed during infestation by Guttar Spray Pump.

The cost analysis made for these two species is depicted in Tables-1 and 2. It is evident from Table-1 that the total calculated fresh biomass at the end of three years is 20.7 t/ha in *Acacia auriculiformis* and 19.6 t/ha for *Cassia siamea*. The total plantation cost of *Acacia auriculiformis* calculated is Rs.45,271.00 while in *Cassia siamea* it is Rs.49,146.25.

Table-1: Total expenditure on plantation for three years

	Package of Work	<i>Acacia auriculiformis</i>	<i>Cassia siamea</i>
I	Land Preparation		
	(a) Ploughing	3750 00	3750 00
	(b) Digging Pits	7500 00	7500 00
II	Manure Cost	3750 00	3750 00
III	Seedling Cost	12500 00	12500 00
IV	Plantation Cost (Labour Cost During Plantation)	3750 00	3750 00
V	Interculturing		
	(a) Weeding	11250 00	11250 00
	(b) Pruning	750 00	750 00
	(c) Thinning	1500 00	1500 00
VI	Aftercare		
	(a) Irrigation	-----	2875 00
	(b) Insecticide Spray	-----	1000 00
	TOTAL	Rs 45271 25	Rs 49146 25
	Survival percentage at the end of 3rd year	82 50	84 60

Values expressed as per hectare basis

The NPW and BC ratios are found out as under

I. Net Present Worth (NPW):

Acacia auriculiformis

- (a) from fuel-wood (3 years)

$$\text{NPW} = \text{Present Worth of Benefits} - \text{Present Worth of Costs} = 52,000 - 45,271.25 = 6728.75$$

- (b) from electricity (5 years)

$$\text{NPW} = 60,000 - 45,271.25 = 14,728.75$$

Cassia siamea

- (a) from fuel-wood (3 years)

$$\text{NPW} = 52,000 - 49,146.25 = 2853.75$$

Table-2: Cost benefit analysis at the end of three years (expressed on hectare basis)

Species	Total Biomass Obtained	Plantation Cost (Rs)	Expected Fuel-wood Value (Rs)	Benefit From *Electricity (Rs)	B C Ratio of Fuel-wood	Ratio of *Electricity
<i>Acacia auriculiformis</i>	20.7	45,271/-	52,000	60,000	1.15	1.33
<i>Cassia siamea</i>	19.6	49,146/-	52,000	60,000	1.06	1.22

* after 5 years, fractions rounded to nearest Rs

(b) from electricity (5 years)

$$NPW = 60,000 - 49,146.25 = 10,853.75$$

II. B.C. Ratio:

Acacia auriculiformis

(a) of fuel-wood (3 years)

$$B.C. Ratio = \frac{\text{Present worth of benefits}}{\text{Present worth of costs}} = \frac{52,000}{45,271.25} = 1.15$$

(b) of electricity

$$B.C. Ratio = \frac{60,000}{45,271.25} = 1.33$$

Cassia siamea

(a) B.C. ratio of fuel-wood

$$= \frac{52,000}{49,146.25} = 1.06$$

(b) B.C. ratio of electricity

$$= \frac{60,000}{49,146.25} = 1.22$$

It can be seen that on the basis of both NPW and B.C. ratio, *Acacia auriculiformis* is a better species.

Prasad (1993) has given a cost-benefit analysis of *Acacia auriculiformis*, for the growth of 15 years. He has also mentioned that survival percentage was around 20%. In the present study, however, attempt is being made to know, a) earliest felling time, b) coppicing capacity, and c) returns from coppicing. To understand (a), above present analysis is done. The survival percentage is not

less than 82 for both the species investigated. This is indicative of suitability of the species.

There are two facets of *Acacia auriculiformis* plantations. On one hand, it can provide short rotation fire-wood (through pruning, thinning or even felling), and on the other hand, it can annually provide fruits which can yield cleaning powder (Bhosale and Kalebere, 1994). The latter can involve womenfolk. Campbell (1993) has stressed that a NTFP based forest management programme could be evolved where men and women can be trained technically. By this, it would be possible to maintain the traditional characteristics of NTFP – by keeping them small and household or community based, and also giving the first option to women.

Thus, *Acacia auriculiformis* has added-value which *Cassia siamea* does not. Moreover, it is not as sturdy as the former.

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Economics of Homestead Production of Bamboos in Kerala: Problems and Prospects

B. Jayasankar and P.K. Muraleedharan

INTRODUCTION

People in Kerala traditionally grow bamboos, largely the thorny variety, in their homesteads mainly as a substitute for timber for construction purposes and thorns for fencing. Bamboo is grown along the plot peripheries of homesteads especially in the central and northern parts of the State. This multipurpose plant plays an important role in providing building materials, poles, rafters, reapers and thorns. In the olden days, due to the relatively low market demand, not much importance has been attributed for bamboo. Bamboo has been considered as a resource of value only with the establishment of pulp and paper mills, using bamboo as the main raw material (Gadgil and Prasad, 1978). As the bamboo from forests are entirely earmarked for pulp and paper industries, the local demand and exports¹ are mostly met from the homesteads. The ever growing demand for bamboo, both from traditional and modern sectors puts immense pressure on the existing resource base. Considering the bias towards the conservation oriented approach to forestry and the present low productivity of bamboo forests in India, which is estimated to be below 2.2 tonnes/ha (Bennet, 1993), the possibility of future supply of bamboos from forests is very limited. Thus, the possibilities of exploiting the other potential sources of bamboos are important. Homesteads can be developed as one of the potential sources of bamboos in the State. Here, an attempt is made to study the economics of household production of bamboos in Kerala, and to analyse the prospects and problems in the cultivation of bamboos in the homesteads.

STUDY AREA AND METHODOLOGY

Of the 14 districts in the State, Palghat District has the highest growing stock of bamboos in the homesteads (KFRI, 1991). A primary survey of bamboo growing households was conducted in the Ottappalam Taluk of Palghat District, which forms the basis for the study. Forty households were selected at random

¹ Exports here means, demand from neighbouring states, viz , Karnataka and Tamil Nadu

from 2 villages, viz., Ambalappara and Thiruvegapura, and the information regarding bamboo stock, area occupied, productivity, income from bamboos, etc., along with the socio-economic status of the households was collected. Most of the selected farmers grow bamboo mainly to satisfy their domestic needs. Thus, the analysis is limited to the study of the economics of bamboo as a homestead crop.

THE HOMESTEAD BAMBOOS : AN ALTERNATIVE

Homestead is an operational farm unit in which a number of crops (including tree crops) are grown in conjunction with livestock, poultry and/or fish, mainly for the purpose of satisfying the farmers' basic needs (Nair *et al.*, 1989). Homestead farming by adopting multiple cropping is common throughout the State. Studies have shown the potential of private lands, especially homesteads in Kerala, as the major source of timber and fire-wood (Muraleedharan *et al.*, 1983; Krishnankutty, 1990). This is also true in the case of bamboos, where almost complete marketed quantity of bamboo is from homesteads (Jayasankar and Muraleedharan, 1993). It is estimated that homestead bamboos in the State account for 22 million culms or 0.408 million tonnes with an area of 9216 ha (if we assume a spacing of 6 × 6 m between the clumps) (KFRI, 1991). The productivity of homestead bamboos in Kerala is 8.35 tonnes/ha. (KFRI, 1991) as against 2.2 tonnes/ha at the national level. Because of lack of awareness, this source has not been commercially exploited yet. Thus, the scope of developing hitherto neglected household sector as the potential source of bamboo is very high. Cultivation of bamboos in the homesteads like other trees, can considerably enhance the future supply of bamboos and also form a supplementary source of income to the households.

PRESENT MANAGEMENT OF HOMESTEAD BAMBOOS

Bamboo can be considered as a relatively high value crop, and is grown in the open and marginal agricultural land. Bamboo is also a potential crop in agricultural lands where the soil and climatic conditions are not favourable for economic cultivation of other agricultural crops (Patil *et al.*, 1991). In Kerala, it is often grown in most of the rural homesteads especially along the fences or in the farm land. The main species grown in the village homesteads in the Palghat District is *Bambusa bambos*. Other species are distributed sparsely.

Homestead crops are mostly managed with the family labour. Bamboo is also managed in the same way though with very low labour input and left to grow naturally. This is usually grown as two or three clumps in each side of the plot periphery. The only labour involved in harvesting this resource is in the form of pruning the thorns or cutting culms. Since bamboo is grown as a hedge

plant along with other live fence trees, no separate land is used for growing bamboo, or it is also grown extensively in the degraded farm lands. It also grows naturally and regenerates vegetatively, without any inputs. When the household needs money or the clump become congested, the clump is sold to the traders. It is estimated that on an average, the farmer will get Rs. 2000-5000 from this resource, depending on the number and size of culms which is controlled by the age of the clump.

About 45% of the sample farmers have homestead area to the extent of more than 0.4 ha. as is evident from Table-1

Table-1: Percentage distribution of sample farmers according to homestead size classes

Homestead size ^a	Number of farmers (Percentage)
≤ 0.1 ha	15.78
0.1 to 0.2 ha	10.53
0.2 to 0.3 ha	13.18
0.3 to 0.4 ha	15.78
> 0.4 ha	44.73
Total	100

The growing stock of bamboo is directly related to the size of homestead, indicating that people with more land prefer to grow bamboos in their homesteads (Table-2). This is true also in the case of other parameters like number of clumps and culms, area occupied, etc. (see Figure 1). This may be due to two

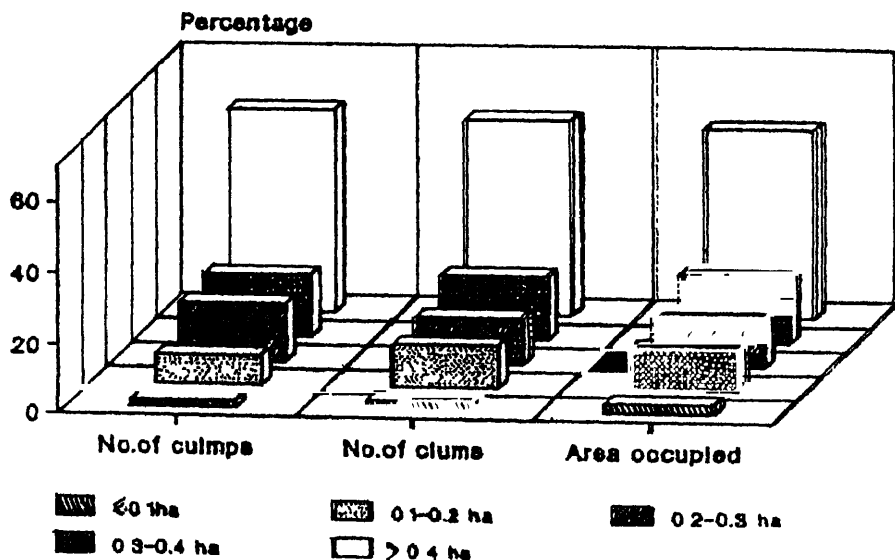


Fig.1: Indicators of growing stock of bamboos according to homegarden size

reasons. 1) since people with more land holding have to fence more area for which they need more quantity of thorns and hence more bamboo clumps, and 2) cultivation of larger holdings requires more investment especially on labour. Thus, the farmer prefers to choose a crop combination of bamboo (which is a less labour intensive crop) and other crops (which may require more labour input) to maximise the income from land.

The average area occupied by bamboo in each homestead is about 12.70 m². If we assume that each clump has a spacing of 6 metres between them, the area will roughly be about 62 m², which is only a small portion of their homestead. The number of culms is more for good clumps and less for small clumps. Good clumps are mostly more than 10 years old. Households, on an average, have 9 clumps with 264 culms (Table-3). Of the total 264 culms, 32 are new shoots.

Table-2: Percentage distribution of indicators of growing stock of bamboo in different homestead size classes

	Size of homestead (in ha)					Total
	<= 0.1	0.1 - 0.2	0.2 - 0.3	0.3 - 0.4	> 0.4	
Number of clumps (Percentage)	1.90	8.57	16.08	17.15	56.10	100
(Number of culms (Percentage)	3.13	12.47	12.93	17.57	53.90	100
Area occupied* (Percentage)	3.00	12.07	14.17	18.75	52.01	100

*Ground space occupied by standing crop in m²

Table-3: Characteristics of Homestead bamboo production

Characteristics	Clump Size			Total
	Good*	Medium**	Small***	
No. of clumps per household	1.79	2.60	5.13	9.52
Area occupied by bamboo per household (m ²)	5.80	3.98	2.92	12.70
No. of culms per household	108.81 (12.76)	75.41 (9.05)	79.83 (10.31)	264.05 (32.12)
Average no. of culms per clump	60.78	29.00	15.56	27.73
Average area occupied by each clump (m ²)	3.24	1.53	0.59	1.33

Values are mean of the sample households

Figures in the brackets show the number of current year culms

*75% or more no. of culms per clump having girth more than 30.5 cm

**75% or more no. of culms per clump having girth between 16.5 to 30.5 cm

***75% or more no. of culms per clump having girth below 16.5 cm

This can be considered as the increment of the growing stock and the same number of mature culms can be harvested sustainably. If they sell this to the traders, it will fetch about Rs.1260²/- per year to the farmer. If we impute the value of thorns from the clump, this will further increase to Rs. 2185 /- per year. This indicates that without any input or other costs, the farmer can earn a good income from bamboos. Generally, for household purposes, farmers need only few culms and they selectively harvest bamboos from the clumps. When they sell the clump to the traders, traders clear fell the same. This destructive harvesting practice delays the next harvest by about 6 to 7 years. The traders never follow the selection system and the householders never insist on this.

CONSTRAINTS EXPERIENCED IN THE HOMESTEAD CULTIVATION OF BAMBOOS

There are several institutional, technological, social and economic factors which directly or indirectly, influence the cultivation of bamboos in the homesteads. Institutional aspects consist of legal barriers like the ban on the free transportation of bamboos (i.e., timber transit rules) which deter the farmers from growing bamboos as a part of agroforestry crop in their farm lands or in homesteads. However, this difficulty can be overcome by obtaining transit permit from the Forest Department. The lack of awareness among the farmers about potential of bamboo as a homestead crop is another reason. In the absence of agroforestry extension, credit facilities, subsidies, etc., the farmers lack incentive to cultivate bamboo.

The present inefficient marketing system is another important hindrance in the development of homestead bamboo production in the State. Though there exists a ready demand for bamboos, because of the lack of standardised pricing system and inefficient marketing mechanism, the farmers get a very small share of the market price. Farm price of bamboo is, to a great extent, determined by the bargaining power of the farmer which is less compared to that of the traders due to the existence of oligopsonistic conditions in the market (Jayasankar and Muraleedharan, 1993).

Non availability of planting materials is an important problem for developing this resource in the homesteads. Many farmers, especially small and marginal farmers, are reluctant to grow bamboo for fear of root competition between bamboos and other cultivated crops. Therefore, they prefer to grow bamboo away from other crops, or resort to dig trenches near the clumps so as to prevent

² Average farm price of good, medium, small bamboo is about Rs. 50, 40, 25 respectively. Here other costs are not included because the household does not have to bear the cost of cutting or transportation which is incurred by the purchaser.

the roots from spreading. Though this method seems to be effective, only a very few farmers are found to resort to this. Another important factor for the decline in the growing stock of bamboos in the homesteads in Kerala is the poor management of the clumps

CONCLUSION

Bamboos can be considered as a potential crop for homestead farming, providing a supplementary income to the farmer without much effort and investment. The present management practices and the inefficient marketing system are the two major factors which hinder the development of this resource in the homesteads. The possibility of identification, and introduction of new species of bamboo which can be grown economically in combination with other crops may have to be explored. Technical parameters like canopy spread, rooting pattern, distribution and standardisation of management practices, etc, have to be studied, and this will go a long way in developing bamboo resources in private lands. Proper extension efforts have to be strengthened to educate the people about the profitability of this crop. These steps will not only enhance the future supply of bamboo but also increase the income of the farmer

ACKNOWLEDGEMENTS

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Plantation Technique and Management, and Growth Features of *Thysanolaena maxima*, a Minor Forest Produce Species of North-east India

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INTRODUCTION

Thysanolaena maxima (Roxb.) O Ktze, commonly known as broom grass is grown as a minor forest produce plant in hilly regions of North-east India. It also grows wild in the hills of North-east and in Darjeeling (Patel 1992) and Sikkim Himalayas (Tewari 1992). The inflorescence of the plant is used in making brooms which are quite popular and fetches good price. These brooms have a ready market in North-east India and they are also exported to other parts of the country in good quantity.

Besides using the inflorescence of the plant as broom for cleaning and sweeping the floor, the leaves of the plant which is a good fodder, are fed to the cattle after the broom grass is harvested. Since the leaves remain green during winter, they also serve as a fodder for stray grazers. The sticks (grass stems) are used as a raw material in the paper industries. However, full utility potential of the sticks in industries is yet to be explored. In addition, the species has high potential for binding soil with its fibrous root system and therefore, it helps in reducing soil erosion. After the harvest, the culm sticks of the plant can also be used as barrier against soil erosion by keeping them across the hill slopes. These sticks subsequently get rotten and add nutrients to the soil. The leaf litter of the plant is also readily decomposable and adds considerable amount of nutrients to the soil system, thereby ameliorating the soils of the plantation plots. This indicates the high potential of the species for its use in eco-restoration of the degraded sites.

In view of the above multiple uses of the broom grass, its large scale plantation may be helpful in uplifting the economic condition of rural poor. However, there is a conspicuous lack of literature on the economic importance, agro-climatic and edaphic requirements, and planting technique and management of the broom grass plantations. No scientific study has so far been

conducted on the species describing its phenology, soil ameliorating potential, growth and productivity.

The present paper describes some of these aspects for wider disseminations of information so that the species could be introduced in other parts of the country having similar elevation, soil and climatic conditions

EDAPHIC AND CLIMATIC REQUIREMENTS

The species grows on a wide range of soil types ranging from sandy to sandy loam. It can even grow in crevices of broken rocks. Field observation indicates its preference for acidic soils (pH 5.0 - 6.0). However, its success on soils having higher pH value has not been investigated. Though the species can grow on nutrient deficient/infertile soil, the yield on such soils is rather low.

The plant grows well up to an elevation of 1800 m, beyond which the climatic conditions are believed to adversely affect the produce quality, i.e., inflorescence. The frost at higher altitudes does not allow the flowers to bloom fully and thus, it may reduce the yield considerably. Broom grass grows under the climatic conditions ranging from tropical to sub-tropical.

PHENOLOGY

Seedlings are of infrequent occurrence, and the plants arising from seeds show poor growth. In nature the plant mostly multiplies through underground rhizomes.

Broom grass is usually planted during April and May, and peak vegetative growth takes place during June-July. The vegetative growth continues till the plant bears inflorescence. In most areas, flowering starts during October. The inflorescence becomes ready for harvest by December-January and the harvest continues till March.

PLANTING TECHNIQUE

The species is planted through rhizomes, which are generally collected from the natural populations. As the plants grow scattered on the hills, collection of rhizome is highly labour-intensive. Broom grass is grown either in monoculture or as an intercrop with *Atrocarpus integrifolia*, *Citrus* spp., *Ananas comosus*, *Psidium guajava*, *Cinnamomum tamala*, and *Michelia champaca*. The spacing maintained in these plantations varies from 3 × 3 m to 5 × 5 m depending upon the associated crop. In monocultures, the spacing is usually 2 × 2 m. The sites are cleaned properly during February/March and planting is done thereafter in pits. The size of the pits depends on the size of rhizome(s). In case the planting

is to be done on the poor sites, cow dung manure is put in the pits before planting in order to obtain better results. Three to four rhizomes of average size are usually planted in a single pit. This helps in getting more shoots per pit. New shoots come up within three to four weeks after planting.

PLANTATION MANAGEMENT

Though the plant grows wild along the hill slopes, the commercial cultivation needs considerable amount of care during post-planting period. In fact, the economic yield of the crop largely depends on the proper management of the plantation. Weed infestation poses the most serious problem and causes considerable reduction in the yield. Therefore, weeding should be done 4-5 times in a year. During the first two years of growth weeding is absolutely essential. As the leaves have good fodder value, the plant is prone to grazing by cattle and thus the plantations get damaged, if grazing is severe. Therefore, a cattle proof fencing is required to be provided. Adequate fire prevention measures need to be taken during dry and winter months. After a crop cycle of five years, the plantation is generally burnt in order to get better shoots from the underground rhizomes.

YIELD AND ECONOMICS

The yield of inflorescence varies depending on the site conditions and the size of rhizomes planted. Maintenance of the plantation has also an important bearing on the yield. On an average, inflorescence yield (on fresh weight basis) per hectare during the 1st year of cropping is about 70 kg, and during the 2nd year it increases to about 180 kg. The yield increases till 4th year, after which it declines. Average inflorescence yield during the 3rd year of cropping is ca. 220 kg and during the 4th year it is ca. 350 kg.

In order to document the spatial variation in yield due to planting technique used, soil conditions, associated crops and variation in selling price of the produce, a study was conducted during May, 1993 at various locations in Meghalaya (Table-1). In view of good economic return from broom grass, the plant is not being cultivated as a cash crop in many parts of Meghalaya both with and without subsidy from the government. The species is also being planted under the Minor Forest Produce Scheme of the government of India implemented through the state forest department, Meghalaya.

The expenditure incurred during first three years of cropping for raising one hectare of *Thysanolaena maxima* plantation in Meghalaya worked out to be Rs 1700/- only (Table-2).

Table-1: Plantation sites, associated crops and economic yield of *Thyrsanolaena maxima* in East Khasi Hills and Ri-Bhoi districts of Meghalaya

Plantation site	Population	Area (ha)	Soil texture	Associate crop	Spacing (m)	Cumulative yield during first 3 years per ha (ton)	Selling price per ton (Rs)
Nongpoh	10,000	145	Sandy loam	monoculture or mixed with <i>Artocarpus integrifolia</i>	2.5 × 2.5 4 × 4	0.9	8000
Jirang	5,000	130	Sandy loam	<i>Piper longum</i> , <i>Artocarpus integrifolia</i> & <i>Cinnamomum tamala</i>	2.5 × 2.5	0.75	8000
Mawky-nrew	2,500	100	Sandy loam	Monoculture or <i>Psidium guajava</i>	2 × 2	—	—
Cherra-punjee	42,000	165	Sandy loam	<i>Cinnamomum tamala</i> & <i>Artocarpus integrifolia</i>	2.5 × 2.5 4 × 4	0.9	—
Shang-pung	25,000		Red loam	Monoculture	3 × 3	1.2	—
Khliehriat	40,000	150	Red loam	<i>Cinnamomum tamala</i>	3 × 3	0.9	3000-4000
Pynursla	34,000	240	Sandy loam	Monoculture	2.5 × 2.5 4 × 4	0.8	—
Byrnihat	*	100	Sandy loam	Monoculture	3.5 × 3.5	4.0	6000
Shillong	1,500	23	Sandy loam	Monoculture	2 × 2 4 × 4	2.8	6000
Kyrdemkulai	*	125	Sandy loam	<i>Zingiber officinale</i> , <i>Michelia champaca</i> & <i>Artocarpus integrifolia</i>	3 × 2.5	1.2	6000

* indicates data not available

Table-2: Expenditure incurred during first three years to raise one hectare of *Thysanolaena maxima* plantation in Meghalaya

Components of expenditure	Amount (Rs)
Survey and land demarcation	50
Clearing of land	450
Cost of planting	300
Weeding (three times per year)	
Ist year	450
IInd year	450
Total	1700

Average net income from one hectare of *Thysanolaena maxima* plantation during a five year cropping period in Meghalaya works out to Rs. 5,320. The year-wise statement of income and expenditure is presented in Table-3.

Table-3: Average income and expenditure from one hectare of *Thysanolaena maxima* plantation during a five year cropping period in Meghalaya

Year of cropping	Income (Rs)	Expenditure (Rs)	Net Income (Rs)
I	420	1250	-830
II	1080	450	630
III	1320	-	1320
IV	2100	-	2100
V	2100	-	2100
Total	7020	1700	5320

GROWTH FEATURES

The growth pattern of *Thysanolaena maxima* in plantations of different ages was studied at selected sites as mentioned in Table-1. The plant grows in tussocks. The culms arise centrifugally during the peak growing season. The appearance and growth of culms in a tussock depict a characteristic order, which probably controls the position and extent of growth of culms, size, number and also length of leaves, and the overall shape of the crown of the tussock.

It was found that the maximum height of tussock increased upto 3 years while basal girth continued to increase even after that and at a considerably faster rate. The average number of culms constituting a tussock and basal area of each culm also increased at a faster rate after the 2nd year of plant growth (Table-4).

Table-4: General growth pattern of *Thysanolaena maxima* in the plantations of different ages in Meghalaya

Growth parameters	Age (Year)			
	I	II	III	IV
Height of tussock (cm)	75 0	100 0	180 0	178 0
Basal girth of tussock (cm)	48 0	83 0	108 0	170 0
No of culms/tussock	24 0	67 0	312 0	428 0
Basal area/culm (cm ²)	1 3	1 9	2 8	3 5

CROWN STRUCTURE

The internode length and area per leaf increased steadily with the age of tussock but leaf number per culm remained almost constant. A substantial increase in average leaf area per tussock was observed during the 3rd year of growth. The maximum area of crown cross-section, however, increased at a much faster rate during the second year of growth. The leaf area index (LAI) was minimum during the second year and maximum during the 3rd year of growth. The growth analysis of crown indicates a very high level of integration of different components forming the crown of the tussock. The central cavity of tussock was devoid of any culm. The culms came up only at the periphery of the system. The vegetative growth attained a peak during the 2nd to 3rd year of growth. As the growth continued, the basal perimeter of the tussock increased and the top surface of the crown became more elliptical and more sparse paving the way for greater exposure of the crown to light. Such a crown structure caused a decrease in LAI. The LAI peaked during 3rd year of growth. After 4th year the tussocks gradually showed the sign of withering and disintegration. During this period, the area of cavity (open central empty space devoid of culms) within the perimeter of the tussock increased at a higher rate. The culms at the periphery of the cavity, help to retain the dead leaf biomass within the cavity, thus conserving the leaf nutrients significantly in the close vicinity of the newly arising culms. This strategy is merely a function of growth pattern of the species, which probably helps the species in terms of nutrient conservation in the close vicinity of parent plant especially at degraded sites (Table-5).

BIOMASS AND PRODUCTIVITY

The dry weight of stem or leaves per culm did not increase significantly with the age of tussock and the overall ratio of leaf to stem weight per tussock during first and second year of growth was around one. The ratio, however, increased slightly during 3rd year and significantly during 4th year. A low proportion (6.2%) of shoot biomass was found allocated to the inflorescence which is the

Table-5: Dynamics of crown structure of *Thysanolaena maxima* in the plantations of different ages in Meghalaya

Structural attributes of crown	Age (Year)			
	I	II	III	IV
Leaf no /culm	6 2	7 0	8 0	8 2
Internode length (cm)	7 5	13 6	25 8	26 9
Leaf area/culm (cm ²)	445 7	520 7	956 6	1102 2
Leaf no /tussock	148 8	470 4	2496 0	2424 0
Leaf area/tussock (cm ²)	11055 9	34997 7	298521 6	472512 0
Area of canopy cross section (cm ²)	4415 6	20096 0	42983 5	96162 5
LAI	2 5	1 7	6 9	4 9
Cavity area (cm ²)	22 8	84 9	162 8	314 0

most valuable product arising at the cost of stem biomass. Total biomass per tussock increased from about 1 kg at the end of first year of growth to about 14 kg at the end of 4th year. The average productivity increased upto 3rd year and was very high at this age. It decreased drastically beyond 3rd year. The net yield was maximum during 4th year of its growth. Thus the growth features and productivity pattern of the species indicate its production potential in degraded environment even in the face of paucity of soil (Table-6). The trends of biomass accumulation and productivity of the species during different years of cropping justifies the on going practice of burning the crop after every five years in order to get better yield.

Table-6: Distribution of above ground biomass (g/plant) in different plant parts of *Thysanolaena maxima* in the plantations of different ages in Meghalaya

Plant components	Age (Year)			
	I	II	III	IV
Stem wt /culm (g)	17 0	18 8	30 0	20 5
Leaf wt /culm (g)	6 0	7 0	8 2	8 0
Total wt /culm (g)	23 0	25 8	38 2	28 5
Stem wt /tussock (g)	408 0	1263 0	6240 0	3424 0
	(49 9%)	(49 4%)	(47 6%)	(25 0%)
Leaf wt /tussock (g)	409 0	1293 0	6864 0	9416 0
	(50 1%)	(50 6%)	(52 4%)	(68 8%)
Inflorescence wt /tussock (g)	-	-	-	856 0
				(6 2%)
Total dry wt /tussock (g)	817 0	2557 0	13104 0	13696 0
Average productivity (g/tussock/yr)	-	1740 0	10547 0	592 0

Broom grass plantation is gradually becoming popular among the villagers, particularly, the marginal farmers in Meghalaya. The state forest departments of Meghalaya and Sikkim have also introduced this plant in social forestry plantations. It has emerged as a good cash crop and has potentials to augment

the income of the poor farmers. The produce from the plant starts coming within a year of plantation because the gestation period is usually about six months only. In view of its attractive economic return, less management cost and nominal input to raise the plantation, and the availability of large areas of uncultivable wastelands which account for more than 20% of the total land mass in the hills of North-eastern India, broom grass could be planted on a large scale and can become an effective instrument for rural development. The growth features of the species as presented in this paper, are suggestive of its potential as one of the compatible components of certain agroforestry systems in North-east India. However, such agroforestry models prescribing the crop combinations are yet to be worked out.

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Section 6

UTILISATION MANAGEMENT

Sustainable Harvest of NTFPs and Forest Management

K.S. Murali and Ravi Hegde

INTRODUCTION

The Non-timber Forest Products (NTFPs) refer to minor revenue generating products such as honey, edible fruits, medicinal herbs, etc., from the forests, and occupy a greater importance in generating income from forest than it is realized. In India alone over 5000 such products are being collected from the forests with an estimated annual revenue of about 135 million US dollars (Pant 1977) from the local tribes, who have the privilege of collecting them from the surrounding forests. Globally, the value of NTFP harvested is approximately Rs.1500-00 (\$50 00) per hectare (Godoy and Lubowski 1992). Owing to such importance of NTFPs in employment and income generation among local people, there is a growing awareness on conservation and sustainable use of NTFPs world over. It is also believed that by integrating efforts of local people with the revenue-generation through NTFPs, it might be possible also to solicit their participation in conserving the biodiversity. It is, therefore, necessary to study the impact of harvesting NTFPs on their regeneration potential in order to advocate the optimum level of harvest for maintaining ecological sustainability. In this paper, we report one such attempt of assessing the impact of harvesting NTFPs on the forest composition in a southern Indian deciduous forest.

Study Site

Biligin Rangaswamy Temple (BRT) wildlife sanctuary, situated in Karnataka, is believed to be a confluence of eastern and western ghats of southern India. Probably because of such confluence, the sanctuary offers a variety of vegetation types from scrub at foothills, moist and dry deciduous and evergreen at mid elevation to sholas at hill tops. The forests are inhabited by a semi-nomadic tribe called **Soliga** who practice shifting cultivation. Since mid 1970's they are accommodated in permanent settlements and forest of BRT is relatively less disturbed compared to forests of other adjacent hill ranges due to less anthropic pressures. However, the situation is fast changing and more and more pressure is being felt in terms of population and land area under cultivation. The present study was taken up in the dry deciduous forest situated at the elevation range of 1000-1200 m above MSL.

MATERIAL AND METHODS

We assumed that the site proximal to the forest will be more disturbed than the site away from the settlement. Around any settlements, the areas near to it are more likely to be intensely harvested than those away, because a) the area of the forest increases as a square of the distance (radius) making the availability for harvest less nearer and more farther from the settlement, and b) the tribals are likely to spend more time around the settlements than away, as it would be economically efficient and logistically feasible. Accordingly, we selected the two disturbed regimes namely, highly disturbed (HD, proximal to settlement) and mildly disturbed (MD, away from the settlement). In each of these two disturbed regimes, five transects of 1000 m length and 10 m width, were laid and the number of trees of different species ≥ 10 cm girth (DBH) were measured. In addition, at every 100 m intervals within the transect, a 100 m² quadrats were laid and all saplings above 1 cm DBH were recorded. The damage to the trees was also recorded. The density of saplings and stems, species diversity and population structure of NTFP and TFP species were analyzed.

Further we undertook experiment on different harvest levels 0, 25, 50 and 100 per cent of the nelli fruits during October 1993, and followed those trees for the seed and seedling densities in the field. This data is expected to give us a clue as to what level of harvest would keep the seedling mortality at minimum.

RESULTS AND DISCUSSION

The cut and damaged stem were high in HD regime as compared to MD regime supporting our assumption that sites farther from the human settlements are less disturbed (Table-1). However, the two regimes contain nearly equal

Table-1: Comparison of various community parameters between mildly disturbed and highly disturbed regimes

Parameters	Mildly disturbed	Highly disturbed
Distance from the settlement	5 - 6 Km	1 - 2 Km
Cut stems (No/ha)	5.4	16.8 ¹
Species richness (number of species)	52	47
Diversity index (Shanon-Weiner)	2.90	2.56 ²
Tree density (No/ha)	321.6	287.8
Saplings (No/ha)	100	29.8 ¹

¹Chi-square was done using values pooled over all hectares, $\chi^2 = 34.7$, $df = 1$, $p < 0.001$

² $t = 7.28$, $p < 0.01$

³Chi-square was done using values pooled over all hectares, $\chi^2 = 123.3$, $df = 1$, $p < 0.001$

number of species. The two regimes differ significantly with respect to density of stems, density of saplings, species diversity and basal areas (Table-1)

It appears that the intensity of harvest has affected the forest structure in terms of species diversity, species dominance, stem density, etc. Especially, the harvest of NTFPs has significantly affected the sapling density, i.e., regeneration of tree species. Such a decreasing trend in saplings could be attributed to three factors. Firstly, the three main species that are harvested for their fruits in this area are *Embluca officinalis*, *Terminalia chebula* and *T. bellirica*. Their fruit collection probably has reduced the seed density in the forest and therefore reduced the sapling density. The trees are also harvested for their leaf, bark, etc., which ultimately reduce the reproductive success and therefore the regeneration potentials. Secondly, due to the movement of people and cattle, the saplings may be trampled. It is also possible, that cattle, which graze in these areas, may consume the saplings.

For any sustainable resources use, we need to consider the replenishment rates of resources (i.e., regeneration potential), rate of harvest and time lag between two successive harvests. This can be very easily interpreted mathematically, provided parameters are known, but for want of clarity and appreciation, we shall represent them graphically (Figure 1). Ideally, the amount of harvest will be greater and the regeneration decreases with increasing intensity of harvest. Depending upon the shape of the curves defining the two parameters, they intersect at a certain point 'B' determining the harvest level at which the product of regeneration and the amount of harvest are maximized. This point 'B' suggests the level of harvest at which ecological sustainability can be

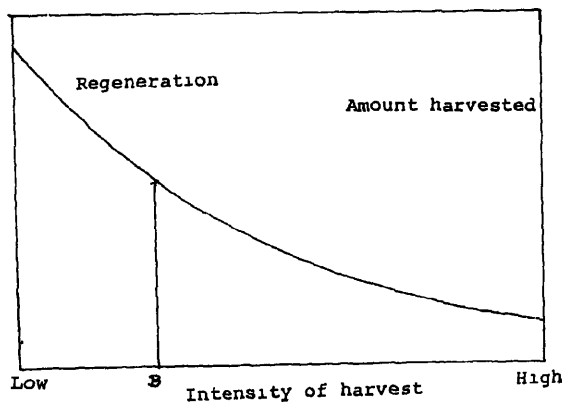


Fig.1: A schematic model showing the assumed regeneration level and amount of harvest over different intensity of harvest. The point B indicates the harvest level at which sustainable productivity is achieved.

achieved. Although we did not determine the optimal level of harvest for BRT hills, our goal is to find this level in future

Our experiments revealed that the number of seedlings found under the trees harvested for less proportion of their fruits, showed lesser regeneration potential than the ones which were completely or where the intensity was high. This confounding effect was due to the herbivore population which depend on these fruits for their food. Our preliminary observations show that Sambar (*Cervus unicolor*) and Gaur (*Bos gaurus*) used to eat the fruits fallen under the unharvested trees, because the density of fruits fallen under such trees were high, and the seeds were dispersed to far off places. The trees with excessive harvesting intensity were not attracting the herbivores, because there were less or no fruits under them, and therefore only those seeds which were left unpicked, regenerated from such harvests. It is probable that such effect of juveniles growing under their parent tree may have deleterious effects and therefore are not recruited for future generation. However, we should also caution that our sample sizes were very small and we need more data in this regard

Our studies also suggest that upto 50% of harvest will give sufficient number of seedlings for perpetual regeneration of nelli species (Figure 2). Here we are assuming that the seedlings at lower harvest levels are attracting the herbivores and the seeds are being dispersed away from the parent trees and therefore we are not capturing them under the focal trees. Therefore, we can safely assume that 50% of harvest of fruits from trees can be demonstrated as sustainable use of the fruits without remarkably losing the regeneration.

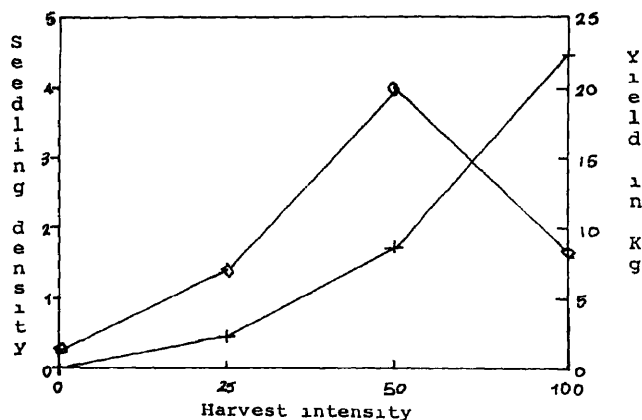


Fig.2: The effect of different harvest regimes on the regeneration of *Emblica officinalis*. Lines with plus indicate the yield at different harvests and the lines with open squares indicate the seedlings per sq m

However, we should also view this recommendation with caution that we may deprive the wild animals their share of food by this level of harvest. Therefore, we need further research which tells more about requirement of wildlife in the sanctuary and probably determine the realistic harvest levels later.

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The Uses and Management of Non-timber Forest Products in Ghana

Dominic Blay, Jr.

INTRODUCTION

Non-timber forest products or NTFPs are materials or goods from the forest with the exclusion of timber which provide goods, services as well as items of trade to rural communities (Falcover 1990). With forests forming an integral part of Ghana and with most communities being rural, non-timber forest products constitute important products which play an important part in the daily lives of rural communities and thus facilitate their daily living.

USES OF NON-TIMBER FOREST PRODUCTS

Abbiw (1993) has described the uses to which non-timber forest products are put. These uses include being used for food, building and construction, household goods, energy production, plant medicines and agricultural equipments. The species used for these variety of purposes and the uses they are put to, are described below.

Food

Forest foods are important for the diet of many rural households. These forest foods include:

- i) wildfruits, which are eaten by hunters, farmers, fieldworkers and a few popular ones are sold in the market. Wildfruits eaten include *Acacia albida*, *Afrosorsalisia afzeli*, *Antrocaryon micraster*, *Bosqueia angolensis*, *Ficus* spp., *Grevia* spp. and *Parkia* spp. ,
- ii) salt substitutes obtained from the wood and root ashes of species such as *Ceiba pentandra*, *Macaranga heterophylla*, *Sterculia rhinopetala*, *Voa-canga africana*, *Calamus deeratus*, *Tetrapleura tetraptera*, etc ,
- iii) wine tapped from the palm trees, such as *Borassua aethiopicum*, *Cocos nucifera*, *Raphia* spp. and *Elaeis guineensis*, with the last two being important source of wine locally while alcoholic beverages are made from *Balanites aegyptica*, *Lannea acida*, *Ongokea gore*, and
- iv) spices and flavouring agents – Local spices are obtained from *Xylopia*

parviflora, *Monodora myristica*, *Parkia clappertoniana*, while flavouring agents are obtained from *Parkia* spp, *Tetrapleura tetraptera*, and *Afromomum melegueta*. In addition to the above uses, mushrooms - from *Termitomyces* and *Volvariella* species are very important food items. Wildlife or bushmeat as it is popularly called, is estimated to account for about 75% of the protein requirements of rural communities

Building and Construction

Many rural households depend on non-timber forest products for the construction of temporary structures such as sheds, barns, pens for livestock and permanent structures such as mudhouses which are built of mud but with wooden skeletal frames, or built completely of wood, bricks or cement blocks with wooden parts.

Species which are used to provide skeletal framework for structures include *Lacosperma opacum*, *Lacosperma secundiflorum*, *Calamus deeratus*, and *Eremospatha hookeri*. Also used as building materials are *Cerestis ofzelii*, *Cachlospermum tinctorium*

In addition to the building materials, roofing materials are also obtained from *Cola gigantea*, *Pterigyota macrocarpa*, *Cocos nucifera*, *Lacosperma opacum*, *Raphia hookeri*, *Elaeis guineensis* and *Borassus aethiopicum*. Grasses obtained from many species are also used as thatching materials

Household Goods

Household goods made of forest products are found in all rural homes. These goods include the popular pestle and mortar for pounding 'fufu' a popular local meal and for other grains. Pestles are made traditionally from *Celtis* sp. However, they could be made from *Albizia zygia*, *Blighia unijuguta* and *Cola chlamydanthia*. Mortars on the other hand are carved from *Terminalia ivorensis*, *Morus mseszygia*, *Azelia africana*, and *Nauclea diderchii*, with the latter being the most popular wood.

Other household goods include stools made from *Holarrhena floribunda*, *Alstonia boonei*, *Funtumia elastica*, *Ceiba pentandra*, and *Lannea acida*.

Others are bowls, plates, cutlery and domestic utensils and these are made from species such as *Azelia africana*, *Cola gigantea*, *Hildegardia barteri*, *Irvingia gabonensis*, *Funtumia elastica*, *Alstonia boonei* and *Hannoa undulata*

Traditional hair combs, which often depict traditional symbolic motifs, are carved from species such as *Cussonia kirku*, *Dialium dunklagei*, *Diospyros gabunensis* and *Pentadesma butyraceum*

Mats which are used as either bedding materials or as screens, blinds, wall hangings and materials on which food items are dried are made from the fibres

of plants such as *Acacia kamurensis*, *Cleistophilis patens*, *Celtis intergrifolia*, *Entanda africana*, *Hildegardia barteri* and the stems of climbing palms such as *Lacosperma opacum*, *Calamus deeratus* and *Eremospatha macrocarpa*, Sweeping brooms are also made from the midribs of the leaflets of palm trees such as those of *Elaeio guineensis*, *Cocos nucifera*, *Raphia hookeri* as well as the main flowering stalks of some grasses which are collected together

Stuffing material for cushions, pillows, mattresses and general padding and upholstery work is mainly obtained from *Ceiba pentandra*, *Bombax breviscupe*, *Bombax buaoapezense*, *Caloptris procera* and *Funtumia africana*

Agricultural Equipments and Tools

Most agricultural equipment and tools such as gun-stocks, hoe handles, axe handles, wooden ploughs, spear shafts, bow and arrows are made from species such as *Acacia siberiana*, *Baphia nitida*, *Dialum guineense*, *Monodora tenuifolia*, *Diospyros kamurensis*, *Acacia farnesiana*, *Ziziphus mucronata*, *Cola laurifolia* and *Picrulina nitide*

Energy Production

Fuel-wood and charcoal from plants provide energy not only for domestic cooking but also for rural industries such as local gin distilling, palm-oil production, clay pot and tobacco curing and fish smoking

The preferred species include *Psydrax subcordata*, *Uapaca heudelotii*, *Trichilia monadelpa*, and *Petersianthus macrocarpus*

Plant Medicines

The use of plants and their extracts have been the main method of treating various illnesses such as Dysentery, Anaemia, Rheumatism, Asthma, Bladder and Kidney troubles, Bronchial and Chest troubles, Crawcraw, Diabetes and a whole lot of diseases in the rural areas

Thus, a lot of plants are used in treating various diseases and production of plant medicines Irvine (1960) reported that more than 800 woody plants alone, not to talk of herbaceous plants, are used as plant medicines

INCOME GENERATION BY NTFPs

In addition to the above uses, the gathering, processing and trading in non-timber forest products generate income for people involved in the above activities These people are mostly marginal men and women who take care of their families with income generated from such activities Thus, these activities

contribute to rural development and also to rural, regional and national economies. Although, no detailed studies have been done yet, preliminary studies on few non-timber forest products in one major-marketing centre in Kumasi, in the central part of Ghana, provided the following details

Marantaceae leaves, used for wrapping and packaging of many products, have a monthly demand of about 32,500 dollars. Trading and processing of rattans produced an estimated total amount of 18,000 dollars while chewing sticks used for cleaning the teeth or for oral hygiene produced 350,000 dollars a month. Bush meat or wildlife estimated at 16,000 dollars a month was also sold. Thus for only these few products, there is a monthly estimate of 406,000 dollars or projected annual estimated value of 5 million dollars. When it is considered that Kumasi market is only one out of about six main marketing centres, not to talk of other centres at the district level, and the potential and income generated at the village level from non-timber forest products could be visualised.

MANAGEMENT OF THE RESOURCE BASE OF NON-TIMBER FOREST PRODUCTS (NTFPs)

The resource base of non-timber forest products occur both in the reserved forest estates and outside these estates. Management of the resource base within forest reserves is under the jurisdiction of the Forestry Department of Ghana. While outside the reserved forest estates, management is under local communities.

However, in the Management Working Plans of Forest reserves for District Forestry Officers, it is stated *inter alia* that the 'yield of non-timber forest produce will be controlled at the discretion of the District Forestry Officer in consultation with the Regional Forestry Officer, bearing in mind the supply situation in the forest and the demand of the produce in question. Permit may be issued after an inspection to ascertain the location of the produce' (Ghartey, 1991).

Thus, the gathering or harvesting of the products is made by applying to the District Forestry Offices for a permit, upon the payment of a small fee. However, unlike timber for which inventory has been made and therefore an estimated annual allowable cut has been fixed, there has been no complete inventory for any NTFP item and therefore there is no information on how much a particular item under NTFP should be harvested annually. Also, there is no proper supervision of the harvesting with the result that one permit could be used over a very long period, normally over-exceeding what was initially allowed. In areas outside forest reserves, harvesting or gathering is done either at no fee or by the payment of a small fee or a token drink to the customary landowner. In these areas also, there is no supervision of how much is to be harvested.

Thus, in both reserved and unreserved forests, there is over exploitation of the products, with the result that there is an extreme pressure on the resource base of some of the products.

IMPROVEMENT OF MANAGEMENT TECHNIQUES

For sustainable supply of the non-timber forest products, there should be proper and effective management of the resource base. However, if the resource base is to be managed properly, the knowledge to do so successfully, must come from increased study of the dynamics of the forest processes, especially those concerned with demography and regeneration of the species as well as the demand for the products. To achieve this, following line of actions are necessary:

- i) an inventory of the species which produce common non-timber forest products, if not all non-timber forest products should be made,
- ii) research on the ecology and silviculture should also be intensified, and
- iii) demand for the products both locally and externally should be determined.

However, some action has been initiated on the inventory and demand on the non-timber forest products by the newly established, Collaborative Forest Management Unit of the Forestry Department. Unfortunately, not much is being done on the ecology and silviculture of the non-timber forest product species basically due to financial constraints.

There is, therefore, an urgent need for funding research on the ecology and silviculture of the non-timber forest products species

However, it is also suggested that in awarding concessions and allocations of yield for exploitation of timber, cognisance should be taken of species which produce non-timber forest products. Thus, when an inventory results show that an area within concession abounds in non-timber forest products that area should be declared 'non-timber forest zone' with no allocation of timber yield in that area. This will ensure that damage to the non-timber forest product species through logging is minimised and that there is effective management through proper supervision of harvesting as well as adequate measures to induce regeneration

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Research Support in Poverty Alleviation of Forest Dwellers through Dhanvantari Project

A.K. Varshney

INTRODUCTION

Gujarat State Forest Development Corporation (GSFDC) Ltd is actively engaged in collection, processing and marketing of MFPs. Most of the activities of forestry are directly or indirectly connected with poverty alleviation. Nonetheless, tribals do not appear to have been given a proper deal for their economic upliftment in spite of systematic work done for a long period in this direction. As the forests all over the world are shrinking, the economic condition of the tribals is becoming more and more difficult. Therefore, it is necessary to review the strategy, certainly to provide employment potential to the tribals at their doorsteps. From this point of view, the Corporation has recently launched a new project for manufacturing various Ayurvedic and Herbal remedies and preparations from MFPs, known as 'Dhanvantari Project'. This activity forms an important aspect of the tribal economy without doing any damage to the forests. It would be pertinent to point out in this context that during the non-agricultural season, this Corporation has been able to generate about 36 lac mandays for the collection charges of various MFPs including Medicinal & Aromatic plants during 1993-94 season. During the year 1994-95, it is estimated that approximately 60 lac mandays would be generated.

DHANVANTARI PROJECT

The project is engaged in processing and marketing of products manufactured from medicinally important plants. The MFPs, including Medicinal & Aromatic plants, are collected by tribals from forest area for this purpose and provide an additional source of employment to tribals.

In order to ensure that the tribals get maximum benefit from MFP collection activity, the processing unit has been started at Vadodara where more than twenty Ayurvedic and Herbal remedies and preparations are manufactured (Annexure-I). It has been noticed that the cost of these items manufactured from medicinal plants by this Forest Corporation comes to be less than their established cost in the market, e.g., Amrita (*Tinospora cordifolia*), Gokshur (*Tribulus terrestris*), Indrajav (*Holarrhena antidysenterica*), Brahmi (*Centella asiatica*),

Shatawari (*Asparagus racemosus*), Aswagandha (*Withania somnifera*), Safed Musali (*Chlorophytum tuberosum*), Yashimadhu (*Glycyrrhiza glabra*), Sankhpushpi (*Convolvulus pluricaulis*), Kaucha (*Mucuna prurita*), Harda (*Terminalia chebula*), Baheda (*Terminalia bellirica*), Amala (*Embellica officinalis*), Aritha (*Sapindus emarginatus*), Shikhakai (*Acacia concinna*), etc. It would, therefore, be obvious that by installing small processing units in the tribal areas, the poverty alleviation programme would definitely gain momentum through an increase in collection rates of various MFPs, used for this purpose. It is worth noting that the Forest Corporations are in a unique position since they are already dealing with the tribals and enjoying their good will

The national market for Herbal and Ayurvedic products in organised sector alone is estimated to about Rs 500 crores, which is growing at 10% higher rate than the market of Allopathic remedies

Similarly market for herbal cosmetics, body and beauty care products and consumers products is quite attractive due to the 'back to nature' campaign. Scope of international marketing is also promising for such products. The Corporation has, therefore, decided to expand into the area of Ayurvedic and Herbal preparations and remedies through Dhanvantari Project. In the initial stage, a model-pilot project is being set up at GIDC Por-Ramangamdi which is about 25 kms from Vadodara at a total investment of Rs 14.43 lac to generate turn over of approximately Rs 50 lac per annum on two shift basis. Products such as various Churans, Tablets, herbal hair-oils and hair-wash, Chyavanprash, etc., are being manufactured here (Annexure I). The second phase of the project is envisaged to be established in the backward tribal area of the state with an investment around Rs 1 to 1.5 crore. The Corporation intends to join hands with a suitable national brand and product in the area of body and beauty care as well as Ayurvedic medicine manufacturing concerns of national standing.

The project is aimed at not only providing reasonably priced pure and quality product to the consumers at large but is also focusses on augmenting collection of existing minor forest produces including the ones which are being collected as well as the ones which can be collected to ultimately enhance income generation for the poor forest-dwellers including tribals. Moreover, the project also envisages to take up extension programmes, for encouraging cultivation of various herbs, shrubs and trees through marginal and small farmers—especially tribals and forest-dwellers, so as to enhance their income under buy-back guarantee. Further, component of international trade is embodied, which aims at earning foreign exchange as well as value-adding instead of marketing raw forestry commodities, to generate higher income which can be passed on ultimately to the forest-dwellers to give them a better tomorrow through economic development.

RESEARCH SUPPORT

India is a veritable garden of Medicinal & Aromatic plants. Also being an epitome of climate, seasons and soils of the world, it is possible to grow all kinds of plants here. There are over 2,500 species with medicinal virtues. Of these, about 500 to 600 plants find regular use in Ayurvedic and Unani system of medicine. India ranks foremost after S.Korea, in the supply of medicinal plants to the industrialised countries of the West and demand for natural drugs has been on increase in the recent years. Further more, the World Health Organisation (WHO) has recommended to all member countries to actively promote native medicines of their country as well as initiate steps to conserve and/or to cultivate medicinal plants so that genuine raw materials become readily available to drug manufacturing units as well as to a large section of consumers. Therefore, it is imperative to take up various aspects of research on medicinally important plants, utilised commercially in the Dhanvantari Project. They are as follows:

- i) cultivation aspects for propagation and multiplication,
- ii) utilisation aspects and identification of the raw material for commercial value of different parts of the plants, and
- iii) marketing aspects and other aspects related with standardization and quality control

Thus, it is necessary to undertake a detailed comprehensive survey of medicinal plants found in Gujarat State (Annexure II). This list of plants is by no means exhaustive. It is only a fragment of the actual medicinal plant wealth seen in Gujarat State. On a rough estimate, it has been found that of the total 900 different varieties of medicinal plants found in the state, more than 750 grow in the forests of the Dangs alone. The hilly forest areas of the Gujarat State have a wealth of herbal medicines which still remain under explored. It is obvious that the tribal people use minor forest products in a big way to cure several types of diseases. Further, detailed exploration, comprehensive survey and collection of ethnobotanic information, chemical studies and screening for medicinal properties may provide cheap and reliable source of medicare to the tribals and other dwellers residing in or around the forests. Keeping the above in view, following areas of investigation have been suggested for research support in the execution and implementation of Dhanvantari Project successfully.

I. Survey

A State-wide survey of all economically important medicinal plants is to be carried out to

- a) assess their available potential in their natural habitat,
- b) to identify the areas of abundant occurrence, and
- c) to identify endangered and nearly extinct spp

II. *Ex Situ* Conservation

A number of valuable medicinal plants have become endangered due to over-exploitation, deforestation, biotic interference and un-scientific utilisation from their natural habitat without proper replacement through artificial regeneration. Hence, studies are to be conducted for their *ex situ* conservation in the nurseries by applying genetic and biotechnical approaches to release improved planting materials for plantation activity at proper sites.

III. Bio-technical Applications

Research is needed to be conducted to identify genetically superior strains of Medicinal plants with regard to:

- a) proper quantification of the part of the plant to be utilised,
- b) the content of active ingredient in a particular part of the plant,
- c) disease and drought resistance,
- d) vigour of growth and development, etc., and
- e) establishment of germplasm bank of important Medicinal plants to preserve their resource for future.

IV. Cultivation

It is imperative to work out the precise package of farm-practices needed for optimum performance of various economically important Medicinal & Aromatic plants in different agro-climatic regions. Here, the research is required to be conducted on following lines:

- a) on the collection of seeds and other vegetative parts from the superior plus plant,
- b) on viability of seeds for planting,
- c) on pre-treatments for seed and other vegetative parts with chemicals and plant hormones,
- d) on method of sowing and planting of the vegetative plant parts,
- e) on standardisation of watering and fertilizer application schedule, and
- f) disease and pest management.

Moreover, research is also required to be carried out on the development of tissue culture techniques as well as vegetative propagation by cuttings, suckers, runners, offsets, bulbs, air-layering, budding, grafting, etc., for propagation and scientific cultivation of economically important medicinal and aromatic plants.

V. Harvesting and Post-harvesting Operations

The concentration of the active ingredient in Medicinal & Aromatic plants varies with age of the plant and season of the year of collection. Hence, research is required to be conducted to find out

- 1) the rotation period to get maximum yield,

- ii) the period of the year in which maximum concentration of the active ingredient is available in the exploitable part,
- iii) technique of harvesting, and
- iv) technique of drying, grading, storage, processing, transport, etc.

VI. Marketing and Socio-economic Aspects and Related Studies

In this regard, research priorities are to be determined in consultation with end-users, including private sector companies, industries and small-scale growers. Following studies are needed

- i) there is a need of proper post-harvest technology inputs and creation of a agency to undertake market survey, to ensure proper returns to the tribals and others engaged in collection and processing of Medicinal & Aromatic plants,
- ii) there is a strong need to ensure people's participation through joint forest management for economic development of tribals and other forest-dwellers,
- iii) there is a need for scientific and technological inputs for improving the processing of the Medicinal & Aromatic plants, to claim the genuineness of the product,
- iv) the research activities should be intensified for upgrading pharmaceutical properties of forest produce having medicinal values, and
- v) there is also a need to intensify research on Medicinal & Aromatic plants providing subsistence to the tribal-folk and raw material for industries. The export potential of various Medicinal & Aromatic plants need to be assessed.

CONCLUSIONS

Gujarat State Forest Development Corporation has been collecting about 55 MFPs. Of these, more than 20 MFPs are being utilised as a source of manufacturing various Ayurvedic & Herbal preparations and remedies through Dhanvanti Project. Moreover, the forests of Gujarat State, particularly the hilly areas, are a rich source of Medicinal & Aromatic plants which have generated a tremendous scope of employment opportunities for local inhabitants especially tribals and other forest-dwellers. Moreover, the tribals have been using the plants since ages for medicinal purposes and possess an immense knowledge which needs to be documented confirming the claims made, with the help of research support. Further, it is necessary to develop such varieties of Medicinal and Aromatic plants which not only yield raw materials in a shorter period but of better quality and in greater quantity by application of genetical and

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biotechnological approaches. Last but not the least, the scope of Dhanvantari Project is so wide and beneficial that if properly and scientifically implemented it can generate employment to all forest-dwellers with comparatively less investment and thereby alleviating poverty.

ANNEXURE-I

A List of GSFDC LTD. Products

Medicinal Products (Dhanvantari)		Minor Forest Products (Dhanvantari)	
Sr No.	Name of Products	Sr No	Name of Products
1	Amalaki churna	1	Honey
2	Aritha churna	2	Amla pulp
3	Amrutha (Galo) churna	3	Aritha
4	Ashwagandha churna	4	Harda
5	Indrajav churna	5	Baheda
6	Kaucha churna	6	Babul gum
7.	Gokhru churna	7	Salai gum (Dhoop)
8	Trifla churna	8	Khair gum
9	Brahmi churna	9	Dhavada gum
10	Bibhitaki churna	10	Gugal
11	Yashtimadhu churna	11	Rosha oil
12.	Rasayan churna	12	Safed musli
13.	Lavanbhashkar churna	13	Charoli
14	Shatavari churna	14	Trifla
15	Shankhpushpi churna		
16	Shikakai churna		
17	Sitopaladi churna		
18	Harda churna		
19	Hingavashtak churna		
20	Amla tablet		
21	Trifla tablet		
22	Harda tablet		
23	Trifla gugal		
24	Chyavanprashavleha		

ANNEXURE-II

List of Medicinal Plants

No	Gujarati Name	Sanskrit Name	Latin Name	Part Used
1	2	3	4	5
Type - Climber				
1	Bhoinkolu	Vidarikand	<i>Pueraria tuberosa</i>	Kand
2	Brahmi	Mandika Parni	<i>Centella asiatica</i>	Leaves
3	Chameli	Jati	<i>Jasminum officinale</i>	Leaves, Flower
4	Chanothi	Gunja	<i>Abrus precatorious</i>	Seed, Root, Leaves
5	Dodi	Jeevanti	<i>Leptadenia reticulata</i>	Leaves, Root
6	Dukkarkand	Vanahikand	<i>Dioscorea bulbifera</i>	Kand
7	Galo	Guduchi	<i>Tinospora cordifolia</i>	Kand
8	Gokarni	Aparajita	<i>Clitoria ternatea</i>	Seed, Root
9	Gudamar	Meshasringi	<i>Gymnema sylvestre</i>	Root, Leaves
10	Hadsankad	Asthisamhar	<i>Cissus quadrangularis</i>	Kand
11	Jangli Adad	Mashaparni	<i>Teramnus labialis</i>	Panchag
12	Jangli Mag	Mudgaparni	<i>Phaseolus trilobus</i>	Panchag
13	Kachaka	Kuberaksh	<i>Caesalpinia crista</i>	Seed
14	Kadva Parval	Patol	<i>Trichosanthes cucumerina</i>	Panchang, Root
15	Kalipat	Patha	<i>Cissampelos pareira</i>	Panchang, Root
16	Kaliupalsari	Krishnasariva	<i>Cryptolepis buchanani</i>	Panchang, Root
17	Kapuri Madhuri	Svetasariva	<i>Hemidesmus indicus</i>	Root
18	Kauncha	Atamgupta	<i>Mucuna prurita</i>	Seed, Root
19	Kidamari	Ishwari	<i>Aristolochia indica</i>	Leaves, Root
20	Kukkadvel	Devdali	<i>Luffa echinata</i>	Panchang
21	Malkanguni	Jyothishmathi	<i>Celastrus paniculata</i>	Seed
22	Morvel	Murva	<i>Marsdenia tenacissima</i>	Panchang
23	Nashotar	Trivit	<i>Operculina turpethum</i>	Root
24	Pahadvel	Patha	<i>Cissampelos pareira</i>	Root, Leaves
25	Pippli	Pippali	<i>Piper longum</i>	Root, Fruit
26	Satawari	Shatawari	<i>Asparagus racemosus</i>	Panchang
27	Shivalingi	Shivalingi	<i>Diplocyclos palmatus</i>	Seed, Root
28	Varahikand	Varahikand	<i>Dioscorea spp</i>	Root, Kand
29	Vardharo	Vridhadaru	<i>Argyrea speciosa</i>	Seed, Root
Type - Herbs				
30	Aghedo	Apamarg	<i>Achyranthes aspera</i>	Seed, Root
31	Akharo	Kokilaksh	<i>Astercantha longifolia</i>	Leaves, Root, Seed

1	2	3	4	5
32	Arduso	Vasa	<i>Adhatoda vasica</i>	Leaves
33	Aswagandha	Aswagandha	<i>Withania somnifera</i>	Root
34	Bavchi	Bakluchi	<i>Psoralea corylitolia</i>	Seed
35	Bhangro	Bhringraj	<i>Eclipta alba</i>	Panchang
36	Chitrak	Chitrak	<i>Plumbago zeylanica</i>	Root
37	Danti	Danti	<i>Baliospermum montanum</i>	Root, Seed, Leaves
38	Darudi	Styanasi	<i>Argemone mexicana</i>	Seed
39	Dhamsso	Dhanvayas	<i>Fagonia cretica</i>	Panchang
40	Dhantura	Dhattura	<i>Datura metel</i>	Seed, Leaves
41	Dholi Musli	Safed Musli	<i>Chlorophytum tuberosum</i>	Root, Leaves
42	Dudhiyovachan g	Kalihari	<i>Gloriosa superba</i>	Root
43	Hansraj	Hansraj	<i>Adiantum lunulatum</i>	Panchang
44	Kalijeeri	Somaraji	<i>Centratherum anthelminticum</i>	Seeds
45	Kalimusri	Krishna Musli	<i>Curculigo orchoides</i>	Root, Leaves
46	Kalmegh	Bhunimba	<i>Andrographis paniculata</i>	Panchang
47	Kapas	Karpas	<i>Gossypium herbaceum</i>	Root
48	Karamda	Karmard	<i>Carisa Carandas</i>	Fruit
49	Kataseriyo	Shijreyaka	<i>Barleria prionitis</i>	Panchang, Leaves
50	Khapat	Atibala	<i>Abutilon indicum</i>	Root
51	Khatibhindi	Latakasturi	<i>Ablemoschatus sp</i>	Leaves
52	Kubo	Dronapushpi	<i>Leucas cephalotes</i>	Panchang
53	Kunvarpatha	Kumari	<i>Aloe barbadensis</i>	Leaves, Juice
54	Kush	Kush	<i>Desmostachya bipinnata</i>	Panchang
55	Kuvadio	Chakramard	<i>Cassia tora</i>	Seed
56	Lilukariyathu	Kalmegh Bhed	<i>Andrographis echinoides</i>	Panchang
57	Mamejava	Mamajjak	<i>Enicostema littorale</i>	Panchang
58	Musali	Saveta Musali	<i>Chlorophytum tuberosum</i>	Root, Leaves
59	Nagarmoth	Musta	<i>Cyperus rotundus</i>	Root
60	Panfuti	Parnabekh	<i>Bryophyllum calycinum</i>	Leaves
61	Ransuran	Vanya Suran	<i>Amorphophallus commutatus</i>	Kand
62	Rasna	Rasna	<i>Pluchea lanceolata</i>	Leaves
63	Salavam	Shaliparni	<i>Desmodium gangeticum</i>	Root, Panchang
64	Saptaparna	Saptaparna	<i>Alstonia scholaris</i>	Bark
65	Sarpagandha	Sarpagandha	<i>Rauvolfia serpentina</i>	Root

1	2	3	4	5
66	Ubhubhoiringni	Brihati	<i>Solanum indicum</i>	Root, Fruit
67	Usheer	Usheer	<i>Vetiveria zizanioides</i>	Root
Type - Shrubs				
68	Yasthimadhu	Yasthimadhu	<i>Glycyrrhiza glabra</i>	Root, Leaves
69	Akado	Arka	<i>Calotropis procera</i>	Root, Bark, Leaves
70	Arani	Agnimantha	<i>Clerodendron phlomoides</i>	Root, Flower
71	Awal	Awartaki	<i>Cassia auriculata</i>	Leaves
72	Bethubhoiringni	Kantkari	<i>Solanum xanthocarpum</i>	Panchang
73	Bharangmool	Bharangi	<i>Clerodendron serra- tum</i>	Root, Leaves
74	Dhavadi	Dhataka	<i>Woodfordia fruticosa</i>	Flower
75	Gali	Nilini	<i>Indigofera tinctoria</i>	Panchang
76	Javaso	Yavasaka	<i>Alhagi pseudalhagi</i>	Panchang
77	Karan	Karvir	<i>Nerum indicum</i>	Root, Leaves
78	Kerdo	Kareer	<i>Capparis decidua</i>	Panchang
79	Mardashing	Avrtani	<i>Helicteres sora</i>	Fruit
80	Mendhi	Madyantica	<i>Lawsonia inermis</i>	Leaves, Seed
81	Ubhubhoiringni	Brihati	<i>Solanum indicum</i>	Fruit, Root, Panchang
82	Vavidang	Vidang	<i>Emblia ribes</i>	Seed
Type - Spreading or Prostrate Herbs				
83	Baam	Nimbrahmi	<i>Bacopa monnieri</i>	Leaves
84	Brahmi	Mandukparni	<i>Centella asiatica</i>	Leaves
85	Changeri	Changari	<i>Oxalis corniculata</i>	Panchang
86	Dharo	Durva	<i>Cynodon dactylon</i>	Panchang
87	Gokharu	Gokshur	<i>Tribulus terrestris</i>	Panchang
88	Lajamani	Ljjalu	<i>Mimosa pudica</i>	Root
89	Nagbala	Nagbala	<i>Sida veronicaefolia</i>	Panchang
90	Satodi	Punarnava	<i>Boerhavia diffusa</i>	Panchang
91	Shankhpuspi	Shankhpuspi	<i>Convolvulus pluricaulis</i>	Panchang
92	Varana	Indrayana	<i>Citrullus colocynthis</i>	Seed
Type - Tree				
93	Amala	Amalaji	<i>Emblia officinalis</i>	Fruit
94	Ambada	Amratak	<i>Spondias pinnata</i>	Bark
95	Ambo	Amra	<i>Mangifera indica</i>	Bark, Seed, Leaves
96	Ankol	Ankol	<i>Alangium salvifolium</i>	Root, Bark, Leaves

1	2	3	4	5
97	Arduso	Arlue	<i>Ailanthus excelsa</i>	Root, Bark
98	Asan	Asna	<i>Bridelia retusa</i>	Root, Bark
99	Ashok	Ashok	<i>Saraca indica</i>	Bark
100	Baheda	Bibhitak	<i>Terminalia bellirica</i>	Fruit, Bark
101	Bakanlimado	Mahanimb	<i>Melia azedarach</i>	Bark, Seed
102	Baval	Babul	<i>Acacia nilotica</i>	Bark, Gum
103	Bhilamo	Bhallatak	<i>Semecarpus anacardium</i>	Fruit
104	Bili	Bilva	<i>Aegle marmelos</i>	Fruit, Leaves, Root
105	Biyo	Vijayasara	<i>Pterocarpus marsupium</i>	Bark, Gum
106	Bor	Badar	<i>Zizyphus jujuba</i>	Fruit, Bark, Root
107	Borsalli	Bakul	<i>Mimusops elengi</i>	Seed, Bark
108	Champakati	Kovidar	<i>Bauhinia purpurea</i>	Bark
109	Charoli	Piyalaka	<i>Buchanania lanzan</i>	Seed, Root, Bark
110	Dhavado	Dhavado	<i>Anogeissus latifolia</i>	Bark, Flower
111	Dikkamali	Nadi Hingu	<i>Gardenia resinifera</i>	Gum
112	Gandhilo Kher	Irmed	<i>Acacia leucophloea</i>	Bark, Gum
113	Garmalo	Aragadh	<i>Cassia fitula</i>	Fruit
114	Gugal	Guggula	<i>Commiphora mukul</i>	Bark, Resin
115	Harde	Haritaki	<i>Terminalia chebula</i>	Fruit
116	Harero	Shakotaka	<i>Streblus asper</i>	Bark
117	Jambu	Jambu	<i>Syzygium cumini</i>	Fruit, Leaves
118	Kadam	Kadamba	<i>Mitragyna parviflora</i>	Bark, Seed
119	Kadayo	Karra	<i>Sterculia urens</i>	Gum
120	Kaddachhal	Kutaj	<i>Holarrhena antidysenterica</i>	Barkresin
121	Kaju	Vankhutak	<i>Anacardium occidentale</i>	Fruit
122	Kaloumardo	Kakaudumbara	<i>Ficus hispida</i>	Root, Bark
123	Kampillo	Kampillaka	<i>Mallotus philippensis</i>	Flower, Fruit
124	Kanjo	Karanj	<i>Pongamia pinnata</i>	Seed, Leaves, Bark
125	Kanchanar	Kanchanar	<i>Bauhinia variegata</i>	Bark
126	Kapith, Kottu	Kapitha	<i>Limonia acidissima</i>	Fruit, Bark, Root
127	Karmal	Bhavya	<i>Dillenia pentagyna</i>	Bark

(Contd.)

1	2	3	4	5
128	Khakharo	Palash	<i>Butea monosperma</i>	Seed, Root
129	Khariyal	Brihat Pilu	<i>Salvadora persica</i>	Fruit
130	Kher	Khadir	<i>Acacia catechu</i>	Bark, Gum
131	Kusum	Kusumbh	<i>Schleichera oleosa</i>	Bark, Flower, Seed
132	Limado	Nimb	<i>Azadirachta indica</i>	Bark, Seed, Leaves
133	Mahudo	Madhuka	<i>Madhuca indica</i>	Flower, Bark
134	Mindhal	Madamphal	<i>Xeromphis spinosa</i>	Fruit
135	Mithandrajo	Svetakutaj	<i>Wrightia tinctoria</i>	Seed
136	Motosissam	Shimshapa	<i>Dalbergia latifolia</i>	Bark
137	Padal	Patala	<i>Stereospermum suaveolens</i>	Root
138	Papada	Chirabilva	<i>Holoptelea integrifolia</i>	Bark
139	Peepar	Plaksha	<i>Ficus infectoria</i>	Bark
140	Piplo	Asppath	<i>Ficus religiosa</i>	Bark
141	Pongaro	Paribhadra	<i>Erythrina indica</i>	Seed, Bark
142	Ragat-Rohido	Rohitak	<i>Tecomella undulata</i>	Bark
143	Ritho	Arishtaka	<i>Sapindus emarginatus</i>	Fruit
144	Sadad	Arjun	<i>Terminalia arjuna</i>	Bark
145	Saledo	Shallaki	<i>Boswellia serrata</i>	Bark, gum
146	Sarasdo	Shrisha	<i>Albizia lebbeck</i>	Bark
147	Sharagvo	Shirgu	<i>Moringa concanensis</i>	Leaves, Bark
148	Shikakai	Saptala	<i>Acacia concinna</i>	Fruit
149	Simaro	Shalmali	<i>Salmalia malabaricum</i>	Bark, Gum
150	Sisam	Shimshapa	<i>Dalbergia sissoo</i>	Bark
151	Sitafal	Shitafal	<i>Annona squamosa</i>	Seed, Leaves
152	Srivan	Gambhari	<i>Gmelina arborea</i>	Bark, Root
153	Tentu	Shyonak	<i>Oroxylum indicum</i>	Bark, Root
154	Thanach	Tinisha	<i>Ougeinia oojenensis</i>	Bark
155	Timbru	Dirgapatra	<i>Diospyros melanoxylon</i>	Bark, Leaves
156	Umardo	Udumbar	<i>Ficus recemosa</i>	Bark, Leaves
157	Vad	Nyagrodh	<i>Ficus bengalensis</i>	Bark, Leaves
158	Varvarno	Varun	<i>Crataeva nurvala</i>	Bark
159	Vansh	Vamsha	<i>Bambusa bambos</i>	Leaves, Root, Flower

Some Aspects of the Methodology of Utilization of MFP: Its Trends and Prospects

K. Vijayalakshmi

INTRODUCTION

India, as is well known, is a treasure house of natural wealth, consisting of a wide range of diversified flora and fauna. This natural wealth is also referred to as Minor Forest Produce or MFP as it is commonly called. It is generally recognised, that all the forest products, other than timber, are referred to as MFP. They may be classified as:

- i) Medicinal plants,
- ii) Aromatic plants,
- iii) Spices,
- iv) Edible materials,
- v) Oil seeds,
- vi) Tans and Dyes, and
- vii) Animal, Mineral and Miscellaneous products.

To deal with all these categories in detail is beyond the scope of this article, and hence it focuses only on medicinal and aromatic plants and spices.

MEDICINAL PLANTS

The MFPs play a very important role in the modern economy. They form the basic raw material for the phytopharmaceuticals and various other industries. Herbal Medicine in use today is derived from nearly 8,200 species of medicinal plants. In developing countries, more than 80% of the population depends on traditional plant based medicine, and even in U.S.A., 25% of the prescription drugs are still based on phytochemicals.

The manufacturers and the practitioners of traditional medicine, depend solely for the procurement of MFP plants from wild, as cultivation of most of these plants barring the spices has not gained momentum.

It is a general practice in phytopharmaceuticals to use raw material in the dried form, because use of fresh material has some obvious drawbacks, namely:

- i) They are very susceptible to microbial degradation,
- ii) They are not available throughout the year, and
- iii) Not all of them can be available in the vicinity of a pharmaceutical unit.

However, the use of dried raw materials is not devoid of its own particular drawbacks, like for instance

- i) Adulteration,
- ii) Substitution with a plant with similar pharmacological activity,
- iii) Degradation of crude drug due to improper storage, and
- iv) Voluminous and therefore expensive transportation, etc

In order to overcome some of these problems, the trend is to use processed raw materials in the form of extracts. Mostly aqueous extracts are used. In exceptional cases however, solvents like aqueous ethanol or rectified spirit may also be used.

METHODOLOGY OF EXTRACTION

Percolation Method

The extraction plant consists mainly of an extractor, a preconcentrator, a final concentrator, a boiler, and a chilling plant.

The plant, to be extracted for drug, is coarsely powdered and packed into the extractor. The boiler is used to generate steam which is let into the outer jacket of the extractor and is the source of heat. The solvent is allowed to percolate the material for 10-15 minutes, and temperature in the still is maintained at 60-80°C during percolation. The extract is drained out through an outlet, and pumped back into the still for re-extraction. This is called a cycle. Each 'wash' consists of 4-5 cycles. Three to five washes are usually done, each time using a fresh solvent.

The extract is now pumped into the pre-concentrator where it is heated and concentrated to contain approximately 20% total solids. The water vapour is condensed and finally chilled in the chilling plant and is reused for condensation. The dilute extract is now let into the final concentrator which is about 1/4th the size of the extractor and the pre-concentrator. Here the extract is further concentrated to get 60-80% total solids and is then drained off into carboys.

The extracts can also be obtained in a dehydrated form by spray drying.

Spray Drying

Here the extract is dispersed as fine droplets into a moving stream of hot gas, where they evaporate rapidly before reaching the wall of the drying chamber. The product dries into a fine powder, which is carried by the gas current and gravity flow into a collection system.

There are three major advantages of the spray drying process: i) Drying heat sensitive materials, ii) Changing the physical form of materials for use in tablet and capsule manufacture, and iii) Encapsulating solid and liquid particles.

Merits of Using Extracts

- 1 The extracts equivalent to the quantity of the crude drug is significantly less
Hence, there can be a substantial decrease in dosage
- 2 The bioavailability of an extract is known to be much higher than that of a powdered drug. This implies greater efficacy because of easier and greater absorption into the body system
3. The process of extraction reduces the microbial burden in the extract, which means significantly lower bio-hazard, and
4. Compared to the powdered drug, the extracts are less voluminous and hence facilitate easy and economical transportation

AROMATIC PLANTS

Essential oils are found in aromatic plants, belonging to about 60 plant families like Laminaceae, Lauraceae, Rutaceae, Myrtaceae, etc. Uses of essential/volatile oils are varied. Their most notable use is in perfumeries, in soaps and other toiletries, for flavouring various food products and even tobacco. Essential oils also serve as antiseptics and stimulants, as ingredients in medicinal preparations, as solvents in the paint industry and also as insecticides.

EXTRACTION OR PRODUCTION METHODS

The essential oils are extracted from plants by:

- 1 Distillation,
- 2 Enflourage or Cold fat extraction,
3. Maceration or Hot fat extraction, and
4. Solvent extraction.

Hydrodistillation

Two general distillation methods are practised. Where the essential oil is immiscible, steam distillation or boiling may be done. On the other hand, where water and the oil are miscible, it becomes necessary, to use fractionation or rectification techniques. These depend upon different boiling or volatilization temperatures of the components to effect separation.

Principle of Distillation

The oil vaporises with steam and is passed through a condensor. On cooling, the oil collects as a layer on the surface of water and is removed, and filtered. This method is used in case of *Eucalyptus*, Lemon grass and Peppermint.

Distillation is distinguished into three types

- i) Water distillation,
- ii) Water and Steam Distillation, and

(iii) Direct-Steam Distillation.

Water distillation: Here the material to be distilled comes in direct contact with the boiling water. The water is boiled either by direct fire, steam jacket, closed steam coil, or even open/perforated steam coil.

Water and Steam Distillation. In this method, the material is supported on a perforated grid or screen inserted some distance above the bottom of the still. The lower part of the still is filled with water to a level lower than the grid. The water is heated by any method mentioned previously. Saturated, wet steam of low pressure rises through the plant material. Characteristics of this method are that the steam is always fully saturated, wet and never super heated. Secondly, the material is in contact with steam only and not with boiling water.

Direct steam distillation. This method resembles the preceding one except that here, live saturated or superheated steam, is introduced through open/perforated steam coils below the charge, usually at pressures higher than the atmospheric

Enfleurage or Extraction with Cold Fat

Certain flowers like Tuberose and Jasmine continue the physiological activities of developing and giving off perfume even after picking. Fat possesses a high power of absorption and if brought in contact with fragrant flowers readily absorb the perfume emitted. This principle, methodologically applied on a large scale, constitutes Enfleurage.

During the entire period of harvest, which lasts from 8-10 weeks, batches of freshly picked flowers are strewn over the surface of a specially prepared fat base (Corps), left there, and then replaced by fresh flowers. By the end of harvest, the fat becomes saturated with the flower oil. The latter is finally extracted from the fat using alcohol and then isolated.

The fat derived after defleurage is called Pomade. It is extracted with alcohol and the alcoholic washings are called Extrait. Complete concentration of Extrait in vacuum at low temperatures result in a concentrated flower oil called the 'absolute of enfleurage'. They are usually dark coloured, and semi-solid because of their fat content.

Maceration or Hot Fat Extraction

The physiological activity of certain plant materials like Roses, Oranges, etc., are stopped by picking. Such materials are extracted by maceration. In this, the same batch of hot fat is systematically treated with several batches of fresh flowers until the fat becomes saturated with flower perfumes. The exhausted flowers are removed and the fragrant fat called the 'Pomade' is obtained. It may be sold as such, or in the form of Extraits or as absolutes of Pomade, which are prepared as in Enfleurage.

Solvent Extraction

Fresh flowers are charged into specially constructed extractors, and extracted systematically at room temperature, with a carefully purified solvent, usually petroleum ether. This solvent penetrates the flowers and dissolves the natural flower perfume together with some waxes, albuminous and colouring matter. The solution is then pumped into an evaporator and concentrated at low temperature. After the solvent is completely removed in vacuo, the concentrated flower oil is obtained.

Oil thus distilled, more truly represents the natural perfume of flowers than those obtained by distillation. However, this method is expensive and cannot replace distillation.

SPICES

These are found naturally and are also cultivated widely. Spices are basically used in confectionery and food-based industries, but they are also known for their medicinal properties. Spices like Ginger and Turmeric are utilized for various ailments in the form of home remedies, and are also used in large proportions in phytopharmaceuticals.

Spices are usually traded in the dried form and are powdered at the consuming centres. Their oils and Oleoresins are also sold.

Oleoresins

Oleoresins are obtained conventionally by extraction of the powdered spice with solvents, but notable differences in the yield and in aroma, flavour and pungency of the final product can be achieved by varying the geographical type of the spice, the age at which it is harvested, the choice of solvents, and the method of extraction.

The Batch Countercurrent method. In this, the powdered spice (30-40 mesh) is extracted by cold percolation through beds of ground material packed in stainless steel columns. The percolation is however rather slow. Fine grinding of the spice, although giving a better yield, often leads to caking of the material and therefore abnormally slow rate of percolation. Fractions of extract containing not less than 10% of soluble solids are drawn off and distilled under reduced pressure to control foaming and particularly to reduce the damage caused by heat on the phytochemical constituents of the oleoresin.

Characteristics of the Oleoresin Usually oleoresins are dark brown, viscous liquids, containing volatile oil. Commercial Ginger oleoresins usually have a volatile oil content of 25-30% and replacement strength of 1 kg of oleoresin for 28 kg of good quality ground spice have been claimed by some manufacturers.

Volatile Oils

It is prepared commercially by steamed distillation of dried spices. Coarsely powdered dried spice is packed evenly into a still. Distillation is carried out with direct steam, and depending on the quantity of the charge, and the steam pressure applied; may require upto a few hours. The distillation waters may be cohobated. Finely ground spice and 'wet' steam should not be used as they cause caking.

Merits of Spice Processing

1. Any desired flavour can be achieved by extracting varying mixtures of the spice of different geographical origins
2. The flavour is always uniform and intense
3. The processed material equivalent to the unprocessed raw material is significantly less in volume and weight. This offers economical and easy transportation
4. Storage problems also are drastically reduced with respect to size, risk of damage by pests, microbial degradation, etc., and
5. There is significant value-addition for the processed material (in terms of price) with respect to the unprocessed raw material

CONSUMPTION, TRENDS AND PROSPECTS

Analysing the given data (Table-1), it is evident, that there are great prospects in international trade of medicinal plants, aromatic plants as well as spices. The graph (Fig. 1) clearly shows an encouraging trend of consumption of processed materials in the form of spice oils and oleoresins.

PROBLEMS AND SUGGESTIONS FOR TRADE OF MFPs

The forest floor is usually covered with annual and biennial herbs. These, if not collected at the right time, are lost to the human kind, by nature's own process of degradation. However, while collecting, it is important to consider survival and regeneration of the plant community for which it is necessary to leave out a certain portion of the plant population untouched. Alternatively, collection may be carried out, after natural seed dispersal has occurred. This practice would also hold good for leaves, flowers and seeds from trees.

In certain trees the useful part consists of the roots and bark. The present practice is to uproot the trees, to collect the roots, and to completely denude the tree to collect its bark. This leads to absolute destruction of the trees, which is a provisional loss in the long term. This can be effectively prevented by adopting

Table-1 Export of Spices During 1988-89 to 1992-93 by Major Commodity Groups
(Qty in M T, Value in Rs Lakhs)

Commodity	1988-89		1989-90		1990-91		1991-92		1992-93(P)	
	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value
Pepper	36908	16451 17	34650	15334 53	29985	10239 93	20535	7431 70	23752	7831 31
Cardamom (Small)	787	1037 36	173	314 11	400	1086 61	544	1557 41	190	750 57
Cardamom (Large)	464	200 10	716	308 92	1077	490 53	910	504 53	1264	863 44
Chillies	7950	1730 42	11967	2571 56	24534	2755 55	32603	8948 49	16887	6768 11
Ginger	6368	940 82	8139	1262 44	6555	1175 79	14259	2188 10	9517	1655 24
Turmeric	18967	1939 28	16900	1613 90	13624	1548 48	19661	3776 22	19665	4835 83
Coriander	8175	591 04	2668	278 41	3488	405 45	9954	1323 47	13644	2082 92
Cumin	1213	391 63	4221	690 47	1029	304 95	1654	637 47	2308	1344 59
Celery	2997	315 89	3089	373 38	3199	414 03	3489	584 58	3138	466 98
Fennel	1099	208 38	2322	310 93	1163	201 22	2136	480 88	2936	700 73
Fenugreek	3575	366 72	6021	426 80	3748	304 56	6375	557 33	5246	566 94
Other Seeds ¹	1387	189 16	1480	173 63	1035	122 59	1282	251 52	1299	261 32
Garlic	4178	230 15	2210	177 34	4023	256 89	10282	828 42	7483	707 37
Other Seeds ²	11906	1171 31	11831	1468 33	11740	1049 06	13512	1831 05	14133	2146 68
Curry Powder	3066	566 26	3330	664 04	3144	660 04	3516	1100 14	2834	1033 03
Spice oils & Oleoresins	576	1857 32	717	2285 77	892	3198 74	1392	6095 45	1261	6663 05
Grand Total	109616	28187 01	110434	28254 56	109636	24214 42	142104	38096 76	125557	38678 11

(P)Provisional

¹Include Ajwanseed, Dill Seed, Poppy Seed, Aniseed, etc²Include Tamarind, Asafoetida, Cinnamon, Cassia, Tejpatri, Kokam, Saffron, etc

Source DGCI & S, Calcutta/Shipping Bills/Exporters' Returns and

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scientific methods of collection, which not only provide the required material, but also save the trees. Hence, training of collectors becomes very important.

The main beneficiaries of this trade must be the collector on one end, and the consumer on the other end. Both are benefited in their own ways, if the raw material is of a good quality. The collector can earn more money by supplying good quality of raw material. As already mentioned earlier, raw material used by manufacturers of herbal medicine, is in its dried form. A superior quality of the crude drug may be obtained by collecting it in the right season, in the right way, drying it appropriately (as required by the nature of the material either in sunlight or in shade), and then partially processing it (cleaning and cutting into bits) and finally the appropriate packaging. This means better preservation of the active phytoconstituents, and hence superior quality. There is a great need

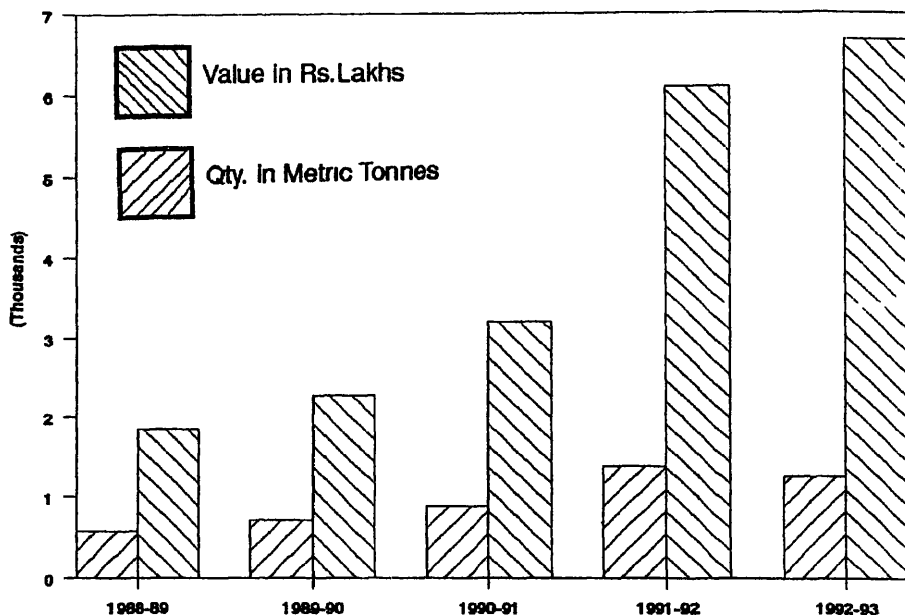


Fig.1: Export of Spice Oils and Oleoresins

to exercise care during drying of the raw material as improper drying makes the material susceptible to microbial (especially fungal) contamination, and hence fetches lesser price in the market.

Adulterated drugs obviously fetch lower prices. However, adulteration in some cases may not be deliberate, but accidental. A collector may unknowingly collect and sell an unwanted plant material along with the actual drug. This may occur due to lack of knowledge as to the proper identity of the drug. This can be solved by training the collectors.

Institutions like the "Centre of MFP" can play a leading role in this area. They can provide the required training for these collectors and also take up projects like growing medicinal plants on wastelands. This may, however, be a difficult project to execute, as there are no standard cultivation packages available for medicinal plants, and there is dearth of seed material even for initiation. A central place at the district level may be selected, where the raw materials from collectors of that area may be bought, and sold collectively. Moreover, economically viable transportation can be possible, if the bulky raw materials can be packed as compact bales. These can be either sold directly to manufacturers or sent to processing units.

One of the most important projects, that can be taken up by such institutions could be research into the actual demand of MFPs in the market. It so commonly happens, that if a particular crude drug is suddenly required by a

manufacturer in large amounts, then there is a rush of activity by collectors to procure that material. And in this rush of activity, more material is collected than is actually required in the market, which leads to a sudden drop in price and eventually the collector is at loss. Hence, there should be established, a rational equilibrium between the supply and demand which is possible only by regular research surveys to know the actual demand.

OVERVIEW

The usefulness of MFPs with respect to its properties as well as its role in economy, is now well recognized and need not be emphasized. However, there are a few suggestions for its better management.

Firstly, the Government should make laws/policies in such a way that it benefits the collector, who is at the grass root level in the MFP trade. The MFP trade should be encouraged, but with an alert eye so as to curb over-exploitation, which may endanger the natural resource.

A panel should be considered, which can monitor the quality of the raw materials, on lines of 'Agmark' or 'ISI' mark. Likewise, unintentional adulteration can be prevented by establishing the correct identity of the crude drug. There exist institutions like Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow which can help in identifying the plants and may even provide necessary training.

Moreover, certain medicinal plants which are problematic for traditional cultivation, can be obtained by means of tissue-culture, in large numbers, and even manipulation can be carried out to get higher content of active principles in them, as well as to develop disease-resistant varieties. More advanced, yet simpler technologies should be developed and made available to the public, so that more number of processing units can be established.

Herbal medicine is now acclaimed globally as one of the best systems of medicine, and hence there is, and will be greater and greater demand for it. Hence, MFP trade should be encouraged, and maximum benefit from this should reach the people at its grass root level, as well as its ultimate consumer.

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Utilisation of Forest Products in Ayurvedic System of Medicine

H L. Vijayalakshmi

Forest products are the fountain source for Ayurvedic Medicines. It has been unreservedly admitted by research scholars that *Ayurveda's Copious Materia Medica* has been mother of all other Medical Systems of the World

In Ayurvedic System of medicines the following forest products are extensively used, namely Medicinal Plants, Honey, Gums, Resins, Oil Seeds, Animal Products and Minerals

Elaborate instructions occur in authoritative treatises about the season, place, and manner of culling medicinal plants and herbs. Brief details are given below for general guidance

- i) in all medicines, articles that are fresh should be used,
- ii) only treacle, ghee, honey, coriander seeds, and the fruits of pippali (*Piper longum*) and biranga (*Embelia ribes*) should be old,
- iii) generally speaking, drugs should be collected in autumn season,
- iv) drugs which are used as emetics and purgatives are taken after the termination of the spring season,
- v) roots should be taken in winter and summer,
- vi) leaves in spring and the season of rains,
- vii) barks, bulbs, and exudations in autumn season,
- viii) piths (the soft spongy substance in the centre of the plant stems) before winter sets in, and
- ix) fruits and flowers should be taken in seasons in which they appear

Scientists, from the developed and under developed countries, have shown keen interest towards medicinal plants, their efficacy in preventing, correcting and curing from common ailments to chronic and incurable diseases.

Brief details of currently used and popular medicinal plants, pharmacological action, therapeutic uses, and mode are given in Appendix-I

Appendix – I

Sl No	Botanical Name	Sanskrit/Local name	Parts of the plant used	Brief description of pharmacological action and therapeutic uses and mode
1	2	3	4	5
Dasha Moola (Ten Roots United Together)				
1	<i>Aegle marmelos</i> (Linn) Correa	Bilva, Bilvam	Fruit ripe & unripe, Bark & Leaves	Ten roots of Bilva, Agnimanha, Sheonail, Gambhari, Patla, Shalparni, Prishanparni, Gokshru, Brahti, Kantapari, united together are called Dasha Moola . These drugs are used collectively and individually in cough, cold, asthma, urinary diseases, joint pain & good tonic after child birth.
2	<i>Clerodendron phlomoides</i> Linn f	Agnimantha, Ganikarika	Leaves & Root	Alterative and bitter tonic, demulcent in gonorrhoea & for children during convalescence from measles.
3	<i>Oroxylum indicum</i> (Linn) Vent	Sheonail	Leaves & Root	Useful in diarrhoea & dysentery.
4	<i>Gmelina arborea</i> Linn	Gambhari	Root, Bark, Fruit & Leaves	Fever, indigestion, loss of appetite & antipoisonous (snake bite).
5	<i>Stereospermum suaveolens</i> DC	Patala	Flowers & Bark	Dyspepsia, fever, cough, dropsy & flowers for hiccough.
6	<i>Desmodium gangeticum</i> (Linn) DC (Hedysarum-gangeticum L)	Shalaparni Sarivan	Whole Plant, Root & Bark	Fever, cough & oil preparation for headache.
7		Prishanparni	Whole plant Root & Bark	Fever, cough & oil preparation for headache.
8	<i>Tribulus terrestris</i> Linn	Gokshru, Negimullu	Entire plant & Fruit	Cough, urinary disorders, calculous affections & tonic.
9	<i>Solanum indicum</i> Linn	Brahati	Fruit, Root, Plant stems	Aphrodisiac, astringent, cardiac tonic, bronchitis & fever.
10	<i>Salanum xanthocarpum</i> Schr & Wendle	Kantakari	Flowers & Fruits	Useful in asthma, cough & lung diseases, etc.
Astha Varga (Eight Vital Roots)				
11	<i>Luvunga scandens</i> (Roxb) Buch & Ham ex Wight	Lavangalata	Berries	Eight roots of Lavanglata, Jivaka, Rishbaba, Riddhi, Vriddhi, Meda, Maha Meda, Kshirakalo, united together are called Astha Varga . Mainly used in Chyavana Prasha and other tonics.

1	2	3	4	5
12		Kshirakakkoli		
13		Rishaba		
14		Jivaka		
15	<i>Gymnema auran- tiacum</i> Wall	Meda	Tuber	
16		Maha Meda	Root	
17		Riddhi		
18		Vridhhi		

Note In case any of the above vital root of *Astha Varga* group is not available, the following drugs may be substituted as equivalent Kshirakakkoli (*Asparagus racemosus* Willd.), Rishaba (*Convolvulus paniculatus*), Jivaka (*Tinospora cordifolia* (Willd.) Miers), Meda (*Physalis flexuosa* Linn.), Maha Meda (*Asclepias pseudo-sarsa* Roxb.), Riddhi (*Sida cordifolia* Linn.), Vridhhi (*Sida alba* Linn.)

POPULAR PLANTS

19	<i>Adhatoda vasika</i> Nees	Vasaka Adusoge	Leaves, Roots & Flow- ers	Cough, asthma, common cold, Phthisis, Consumption to check bleeding diarrhoea, dysentery and as insecticide
20	<i>Tinospora cordi- folia</i> (Willd.) Miers (<i>Cocculus cor- difolius</i> Willd.)	Amritha Amri- tha Balli	Stem, Root Leaves	To be collected in the hot sea- son, Guduchi satwam, valuable bitter tonic in Ayurvedic Pharmacopoeia Fever, com- mon cold, bhasmas in many urinary & liver disorders
21	<i>Eclipta alba</i> , Hassk, <i>Eclipta erecta</i> Dalz & Gibs	<i>Bhringaraj</i> <i>Garage</i>	Roots & Leaves	Liver disorders, anaemia/jaun- dice chronic skin diseases, for hair growth and to prevent grey hair
22	<i>Aloe littoralis</i> Linn	Kumari Loli Sara	Leaves, Roots & Pulp	For liver disorder, jaundice, anaemia / eye diseases, (pulp extract) ulcers
23	<i>Holarrhena anti- dysenterica</i> Wall	Kutaja, Korasi- ginagida	Bark, Seeds & Leaves	Dysentery, uterine diseases, in diarrhoea to check excessive bleeding
24	<i>Herpestus moniera</i> H B K	Brahmi	Whole plant, Root, Leaves, Stalks	Uterine diseases, nerve tonic & mental depressions, loss of memory, urinary disorders, diarrhoea, epilepsy & headache
25	<i>Withania somni- fera</i> Dunal	Ashvagandha, Winter Cherry	Roots, leaves	Nervous weakness, rheumatic and joint pain, general tonic, improvises vigor and vitality & uterine diseases
26	<i>Datura alba</i> Nees, <i>Datura stramonium</i> Linn	Kanaka Dattura, Sadah Dhatura, Ummatay	The whole plant, Leaves, Seeds, Roots, dried ripe seeds, Fruit, colour of the Flowers, white, purple, etc	Asthma, cough, swelling, pain- ful joint & poisonous bites

1	2	3	4	5
27	<i>Woodfordia floribunda</i> Salis , <i>Woodfordia fruticosa</i> Kurz	Dhatakī Tamara Pushpi	Bright red flowers	In preparation of Asava + Aris- tha fever, liver disorders, dysen- tery, diarrhoea and haemorrhages, as a lotion in wound cleaning
28	<i>Vuex negundo</i> Linn	Nirgundi Bile-Neekki	Root, Fruit, Flowers, Leaves & Bark	For painfull joints, muscle, ear diseases and hair growth in the form of oil
29	<i>Leucas cephalotes</i> Spreng	Drona Pushpi, Tumba,	Flowers & Leaves	Cough and colds, bronchitis, headaches, & are used as anti- poisonous
30	<i>Calotropis gigantea</i> (Linn) R Br ex Ait , <i>Calotropis pro- cera</i> (Ait)R Br	Arka Purple or Red Flower Ekke- male alarka (White Flower)	Root, Bark, Flow- ers, & Leaves	Oil used in joint pain, oedema, skin diseases & poultice applica- tion
31	<i>Terminalia arjuna</i>	Arjuna billi Matti, Hole Matti	Bark	Astringent, cardiac stimulant tonic, diarrhoea, dysentery and sprue heart diseases, wound cleaning, healing & venereal dis- eases
32	<i>Boerhavia diffusa</i> Linn	Punarnava	Red & White Herb root	For oedema, heart disease, uri- nary disorders, spleen and liver enlargement, anaemia & dropsy
33	<i>Amoora rohitaka</i> Wight & Arn	Rohitaka		Enlarged glands, liver & spleen diseases and corpulence
34	<i>Bauhinia varie- gata</i> Linn	Kanchanara, Kempu Mandara	Bark, Roots, Buds & Gums,	For enlargement of glands, piles, diarrhoea, reducing fat and obe- sity, tumours, skin diseases
35	<i>Plumbago rosea</i> Linn , <i>Plumbago zeylan- ica</i> Linn	Chitraka (Red) Chitraka (White) Chitramoola	Root	Used in uterine diseases, skin diseases, digestive disorders, dyspepsia, piles & diarrhoea
36	<i>Saraca asoca</i> (Roxb) De Wilde	Ashoka	Bark, Flowers	Uterine, sedative & tonic Dysentery
37	<i>Cassia lanceolata</i> Wall	Sonamukhi	Pods	Laxative
38	<i>Hemidesmus indicus</i>	Anantamul, Namada Beru, Sughandapalada Gida	Root, Bark juice	Nutritional disorders, fever, skin diseases, chronic rheumatism, syphilis, tonic & blood purifier
39	<i>Rubia cordifolia</i>	Manjista	Dried root	Skin diseases, oedema, blood purifier, colouring agent, urinary diorders & diseases

1	2	3	4	5
40	<i>Asparagus racemosus</i> Willd	Shatamuli, Shatavari	Roots, Leaves	Tonic, acidity, nervous disorders, aphrodisiac, uterous disorders & ulcers
41	<i>Glycyrrhiza glabra</i> Linn	Yashti-Madhu	Peeled Root	Tonic, gentle laxatives Skin diseases (externally and internaly)
42	<i>Desmodium gangeticum</i> (Linn) DC (Hedysarum gangeticum)	Sarivan	Whole plant, Root & Bark	Blood purifier, skin disease & nervous disorders
43	<i>Sida rhombifolia</i> Linn	Atibala, Mahabala, Bala,	Roots & Stems	Rheumatism, muscles & joint pain
44	<i>Withania somnifera</i> Dunal	Ashwagandha, Sogade Beru	Root & Leaves	Tonic, alterative, astringent & aphrodisiac
45	<i>Ricinus communis</i> Linn	Eranda, Castor Oil Plant	Tender shoots, Oil, Leaves, Fruits & Seeds	For krimi, mootra kricharam, rakta pittam, roots are used external and internal in joint, nervous, rheumatism, laxative & purgative
46	<i>Terminalia chebula</i> Retz	Haritaki, Aleleka	Dried fruits	Used in majority of Ayurvedic medicines, mainly stomach disorders, constipation and externally in the combination of oil and gentle laxative
47	<i>Terminalia bellurica</i> Roxb	Vibhitaki, Tarikai	Dried fruits	Eye diseases, stomach disorders & hair growth
48	<i>Zingiber officinale</i> Rosc	Vana-Ardraaka Sunta, Ginger Hashi Shunti Vona Shunti	Scraped and dried green	Mainly as spice, digestive, cough, cold & asthma
49	<i>Canscora decussata</i> Schult	Shanka-Pushpi	Entire plant fresh juice	For nervous debility, in the form of fresh juice, nervine, alternative tonic & enhances memory
50	<i>Bambusa arundinacea</i> Willd	Vamnsa-Lavanum Bedru Bamboo Hind	Young shoots Leaves, Seeds, Roots,	Bamboo manna, tonic astringent, anti spasmodic and aphrodisiac vomiting, palpitation and fevers, cough, cold Bamboo leaf buds are used for uterine diseases Tender shoots are used in pickles & curry Banslochan—a white deposit from nodes given to pregnant mothers & children
51	<i>Piper longum</i> Linn <i>Piper cubeba</i> Linn f	Pippali, Hippali	Immature berries dried in the sun, Stems (roots)	Carminative and alterative tonic, aphrodisiac, diuretic and more powerful than black pepper to check haemorrhage, cold, cough liver, spleen disorders & throat diseases

1	2	3	4	5
52	<i>Piper nigrum</i> Linn	Black Pepper, Kalimirsch	Dried unripe fruit	Mainly as spice, carminative, anti- periodic medicinally important, used in combination, with other drugs, cough, cold, asthma, digestive, throat & skin diseases
53	<i>Myrtus caryo- phyllata</i> Linn	Lavangha, Cloves	Fruit, dried Flowers, Buds and Oil	Mainly as spice and medicinally as fragrant and combination with other drugs for cold, cough, digestive & headache, throat pain & tooth ache
54	<i>Cinnamomum cassia</i> Bl	Cinnamon Dalchini, Thwak	Dried inner bark and essen- tial oil, Leaves & Root	Fragrant, medicinally with other drugs, headache, cold, cough, digestive, & throat disorders
55	<i>Cinnamomum inerns</i> Reinw	Tejpatra, Tamala- patra	Leaves, Bark & Oil	Medicinally with other drugs, head- ache, cold, cough, digestive, throat disorders, fragrant & condiment
56	<i>Elettaria cardamomum</i> Moton	Ela, Cardamon	Dried ripe, Seeds, Oil & Fruits	Fragrant, condiment, medicinally with other drugs, liver disorders acidity, diarrhoea, vomiting, cough, cold, uri- nary disorders & burning sensation
57	<i>Crocus sativus</i> Linn	Saffron	Dried stigmas & styles	Fragrant, condiment, tonic for all liver disorders, cough, cold, used in preg- nancy, child birth & aphrodisiac
58	<i>Mesua ferrea</i> Linn	Cobra Saffron Nagakesara, Nagapushpa	Flower buds, Flowers, Fruit, Seed, Root/Bark, Oil	Fragrant, tonic for heart, anti- spasmodic, diuretic, bronchitis & used with other drugs
59	<i>Nelumbium speciosum</i> Willd	Lotus White, Pink, Blue	Entire plant (Padmini) Flowers, fila- ments, anthers, Roots, Seeds/ & Leaves	Useful in diarrhoea, cholera and liver complaints, cardiac tonic, eye dis- eases, uterine diseases & inflamma- tion
60	<i>Moschus mus- chiferus</i>	Kasturi, musk	Musk-from Animal, Deer (Frequently adulterated)	Acts principally on the heart, nervous system, nervous tonic, used as per- fume
61	<i>Santalum album</i> Linn	Srigandha	Wood, volatile Oil	Externally oil and powder, used for skin, diseases, Internally liver disorder, uterine, urinary diseases, (liquid extract, pills, pastes)

*Animal

(Contd)

1	2	3	4	5
62	<i>Ficus bengalensis</i> Linn	Vata, Banyan Tree, Aladamara	Milk juice & Bark,	Tonic astringent, haemorrhage, & also in external application
63	<i>Ficus religiosa</i> Linn	Aswatha, sacred fig, peepul tree & ashvathamara	Root, Bark & Leaves	Ulcers, various skin diseases, scabies & leucorrhoea
64	<i>Ficus mysorensis</i> Heyne	Ghoni (Kan)	Root, Bark	
65	<i>Ficus infectoria</i> Roxb.	Plaksha & Basari	Bark	Rakta dosha & moorcha
NOTE Aswatha, Vata, Ghoni, Plaksha and Udumbara are called Panchavalkala group				

Leafy Vegetables

66	<i>Mentha arvensis</i> Linn	Pudhina	Entire plant	Medicinal & nutritional values, advised in the regular diet
67	<i>Ocimum sanctum</i> Linn	Srithulasi	Entire plant & Leaves	Medicinal & nutritional values
68	<i>Trigonella foenum-graecum</i> Linn	Methi	Entire plant & Leaves	Medicinal & nutritional values & advised in the regular diet
69	<i>Bassella alba</i> Linn <i>Basella Rubra</i> Linn	Bassle (Red & White)	Entire plant	Medicinal & nutritional values & advised in the regular diet
70		Dodda Patre	Entire plant	Medicinal & nutritional values & advised in the regular diet
71	<i>Coriandrum sativum</i> Linn	Coriander	Entire plant	Medicinal & nutritional values & advised in the regular diet
72	<i>Moringa oleifera</i> Lam	Drum Stick	Leaves, Flower, & Fruit	Medicinal & nutritional values, advised in the regular diet

Fruits

73	<i>Feronia elephantum</i> Corr Wood Apple	Kapitha, Bela, Belpatri-phal	Fruit, Gum, Leaves, Bark & Pulp	Used as fruit, lehya and liquid extracts are used in sore throat and gums, diarrhoea and as diet in convalescence after diarrhoea
74	<i>Punica granatum</i> Linn	Dadima-phalam, Pomegranate, Dalimbay,	Flowers, Rind of fruit, fresh fruit, juice, dried bark of the stem & root	As a food and medicine for diarrhoea, malaria and seasonal fevers, uterine diseases, dysentery & to check bleeding

1	2	3	4	5
75	<i>Ficus glomerata</i> - Roxb	Udumbara, Cluster Fig, Atti,	Root, Root bark, Leaves, Milky-juice & Galls	Astringent, carminative, vermicide, useful for both external and internal applications
76	<i>Barringtonia acutangula</i> Gaertn	Dhatrphal	Root, Bark, Leaves & Seed	Used collectively for uterine diseases, to arrest profuse bleeding, used as lotion for healing internal ulcers & wounds
77	<i>Eugenia jambolana</i> Lamk	Jambu, Black plum, Black berry, Naeralay	Fruit, Leaves, Dried seeds, Bark	As a fruit, chronic diarrhoea and dysentery, sore throat, powdered seeds used in diabetic
78	<i>Embluca officinalis</i> Gaertn	Amalaki, Nellikai, Indian gooseberry	Dried fruit, Nut, Seed, Leaves, Ripe fruits, fresh & dry	Liver disorders, ulcer, acidity, stomach disorders, eye diseases, hair growth and to prevent grey hair
79	<i>Carica papaya</i> Linn	Papaya tree, perangi	Milky juice, Pulp & Seeds,	Liver disorder, anthelmintic for round worms, nervous pains, reduces swellings, used as fruit & vegetable
80	<i>Musa sapientum</i> Linn	Kadali, Vanalaxmi, Palntain or Banana	Fruit, Leaves & Stems	As a fruit and vegetable, nutritious and delicious Flower as astringent in diabetic, constipation, diarrhoea and dysentery
81	<i>Ficus carica</i> Linn	Anjira, Anjur, Fig tree	Dried fleshy receptacles	Maximum sugar content from the fruits collected during March and April (India) used in dysentery, bleeding piles, constipation, fever, burning sensation and uterine disease
82	<i>Myristica fragrans</i> Houtt	Jati-phalam Nutmeg, Jajikai	Dried seeds & kernel	For krmi, impotency, diarrhoea, flavouring agent & condiment
83	<i>Vitis vinifera</i> Linn	Drajsha, Grapes, Drakshi (Dried-fruits) Raisins	Fruit, ripe, unripe, Raisins, Leaves	Widely used in medicines, tonic, fever, acidity, skin diseases, blood purifier, liver disorders & highly nutrient

Edible Oil from Forest Trees of Western Ghats — *Garcinia cambogia* and *Garcinia indica*

N. Narasimha, M.G. Chandrakanth and K.S. Krishna

The Western Ghats stretching from South of Nilgiris and up to Konkan Northward is a treasure of forest wealth including Non-timber Forest Products (NTFPs), medicinal, aromatic and oilseed plants along with valuable timbers. Amongst them are two important medicinal and edible oilseed trees, which contribute substantially to the economic development of the local inhabitants of the Western Ghats. These are, *Garcinia cambogia* and *Garcinia indica*. *G. cambogia* is popular as an edible oil plant whereas *G. indica* is known for its medicinal values though it also yield edible oil.

In this study, we intend to analyse the gathering and processing activities by the local inhabitants along with costs and returns of *G. cambogia* (known as 'uppage' in vernacular) and *G. indica* (known as 'murgala' in vernacular).

These two species are commonly found in the evergreen forests of North Kannara, (Sirsi, Kumta, Honnawar and Bhatkal taluks), Shimoga (Sagar, Thirthahalli, Hosanagara taluks) Chickmagalur (Koppa, Sringeri, Mudigere taluks) South Kanara (Sullia and Belthangadi Taluk) and Coorg District. These trees are found growing from Konkan southward to Travancore and the Shola forests of Nilgiris up to an altitude of 6000 ft (Anonymous 1956). There are hardly any effort to grow them on cultivated lands. However, *G. indica* can be seen domesticated in few places of North Kanara Districts in the backyards of the houses.

METHODOLOGY

A reconnaissance survey was undertaken in six villages namely Kulimane, Maligemane, Nelemav, Banagar, Heggur and Golgod consisting of about fifty families of gatherers, processors and traders in North Kanara District. Fruits which consist of rind (outershell) and seeds are economically the most important part in both the species of *Garcinia*. However, the leaves are used as green manure and wood for match box and splints. The chief characteristics of both the species are given in Table-1.

Table-1: Chief characteristics of *Garcinia* species

Sl No	Characteristic	<i>G indica</i>	<i>G cambogia</i>
1	Habitat	Tropical rain forests of Western Ghats	Evergreen forests of Western Ghats
2	Tree	Slender, evergreen with drooping branches	Small-medium sized, with rounded crown and horizontal or drooping branches
3	Leaves	Dark-green above and beneath, ovate or oblong, lan- ceolate	Dark green, shining, elliptic obovate
4	Flowering & Fruit- ing period	Flowers during Nov -Feb & fruit ripens in April-May	Flowers during Feb - April and fruit ripens in June-July
5	Fruits	Globose or spherical, dark purple when ripe, without grooves and contains 5-8 large-sized seeds with sweet taste and flavour	Ovoid, yellow or red when ripe with 6-8 grooves and contains 6-8 seeds, edible but too acidic

COLLECTION AND PROCESSING

a) Background

These two species are commonly seen in the lands of forest department (Government), though they are also seen in the Malki lands (like soppina betta lands, byana lands and backyards of houses) In North Kanara, farmers have very well defined property rights of ownership of land for the use of *Areca* gardens, which means free foliage, grass and small timbers which are used for agriculture purpose, granted by the then British Government These are called as Malki lands Hence, the collection of ripe and fallen fruits in the forest lands is the right of any local individual on first come basis, whereas the fallen fruits in the Malki land will be the sole right of the owner

b) Collection

(i) *G indica*

When the plants (trees) are at the Malki land, the ripe and fallen fruits are normally collected by the owner in his leisure hours of the day During the month of April-May, *G indica* fruits are ripe, and the fallen fruits are collected during morning hours from forests, walking 3-5 kms a day, spending about 5-6 hours, collecting 8-10 kgs of the fruits The gathering of such fallen fruits is once again the privilege extended by the forest department

The fruits, when collected, are washed in clean water and deseeded by separating seeds from the rind. The seeds are washed and sun dried. The rind is also dried in sun for a week or two. Such dried rind is used as substitute for tamarind, which also imparts flavour to curry. The other way of using fresh rind is that it is mixed with equal quantity of (some times little more) sugar and boiled to get a particular consistency, and when cool, is stored for future use as a squash. The fresh rind is also squeezed and mixed with adequate quantity of sugar and water to serve as cold drinks during hot months (April-May).

The dried and stored seeds of *G. indica* are opened to get kernels by the ladies in the family at their leisure hours of the day. Kernels will be fried to a desirable odour and dark brown colour. Such fried kernels later stone crushed to a smooth paste and heated to boiling. The boiled paste will be kept for settling down for about 2–3 hours and mixed with cold water. Now the *G. indica* oil will start solidifying. Oil will be collected and made to an egg shaped ball or cake. Usually, it will be of light grey or yellowish in colour. This process gives about 30% oil, though the oil content of kernel is about 44% (Table-2)

Table-2: Table showing comparative chemical composition of *Garcinia* oils

Sl No	Composition	<i>G. indica</i>	<i>G. cambogia</i>
1	Melting point (M P)	39.5° – 40°C	37°C – 39°C
2	Sap val (sap equiv)	299.5	203.5
3	Iod – val	37.4	52.5
4	Free Fatty acids (% as Oleic)	7.2	0.4
5	Oil content of the seed kernel	26% (44%)	31% (36%)
6	Acidity (Tartaric acid)	3.7%	8.5%

Garcinia indica has a high melting point of 40°C which shows that it is highly saturated (Table-2)

ii) *Garcinia cambogia*

The fallen fruits are collected from June–August, every year with July month, being a peak collection period. In this case also women folk are the major gender spending about 6 hours a day, traversing about 4–5 kms collecting 9–10 kgs fallen fruits. About 35–40 trees are covered in 6 hours of the collection. Fruits are opened to separate seeds and rind. Seeds are washed and mixed with ash to remove the jelly substance covering them and dried either in sun or on the flame. Such dried seeds lose about 25–30% of the weight. Later on, during leisure hours of the day, seeds are opened to separate kernels by women members of the family. Kernels are fried to get sweet flavour and brown colour. Such kernels are stone crushed to get a smooth paste and heated to boiling. The boiled

paste is kept for cooling and allowed to settle down for a day. Now the oil will accumulate at the top and it will be decanted. Such 2–3 decanting process yield about 19% of oil though the oil content of kernels is 36% (Table-2)

The wet rinds are dried over flame until it shrinks to almost 50% of the original size and turns to dark colour. Dried rinds are a wonderful substitute for tamarind in parts of Karnataka and many places in Kerala. The economics of costs and returns of gathering and processing of *Garcinia* species are shown in Table-3.

The cost of processing a kg of *G. indica* is Rs 24.15, whereas *G. cambogia* is Rs.37.25. The input price offered in the barter market is around Rs 80/- and 70 per kg respectively. Thus, the gatherers gain relatively more benefit, if they gather and process the fruits to oil. The processing cost of converting wet rind to dry rind works out to Rs 16.71 per kg and 21.03 per kg for *G. cambogia* and *G. indica* respectively, while price offered in market is Rs 11/- and Rs 15/- per kg of dry rind.

The high price in the barter market for oil may get discounted, if more markets open up for these two precious edible oils, and also if better oil extraction methods (mechanised) are used, since the oil is presently extracted mostly by a crude local method by the gatherers themselves.

The price offered for dry rind per kg also varies with the sources of buyers. The present bulk sales by the forest department through open tenders, especially for *G. cambogia* has resulted in indiscriminate harvesting of fruits by the contractors, who are normally outsiders. In addition to this, the demand for both the species of dry rind has also resulted in indiscriminate harvesting by the contractors. Contrary to this, local dwellers follow the most sustainable mode of harvesting, gathering only fallen fruits and seeds, chewed and thrown by animals and birds.

Presently, promoting a sustainable method of harvesting, similar to that followed by the local dwellers needs to be stressed upon. Further, research on chemical composition of both the species of oil and rind would provide for consumptive value, dietary aspects, along with nutritional and bio-chemical properties. This information may also help in opening a way to improve the domestic consumer's as well as trader's economics and standards of living, as it is a very important supporting subsidiary cottage enterprise.

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Table-3: Comparative gathering and processing costs and returns of *Garcinia* spp

Sl No	Particulars	Yield cost and returns (in Rs) of	
		<i>G indica</i>	<i>G cambogia</i>
1	<i>Imputed labour cost of gathering¹</i>	Rs 20 – 00	Rs 20 – 00
2	<i>Processing seeds to oil</i>		
	Qunty of dry seeds from 4 kg of wet seeds =		
	(a)	3 0 kg	3 0 kg
	Qunty of oil realized from 3 kg of dry seeds = (b)	0 90 kg	0 56kg
	Value of oil (Rs 80–00 /kg & 70–00 /kg respectively) = (c)	72 – 00	39 – 20
3	<i>Processing wet rind to dry rind</i>		
	Qunty of dry rind from 6 kg of wet rind	3 0 kg	3 0 kg
	Value of dry rind (Rs 15 – 00 / kg & Rs 11 – 00/kg resp) = (e)	45 – 00	33 – 00
	Total returns from oil + dry rind (c + e) = (z)	117 –00	72 – 20
	Percentage of returns from oil (c–z)	61 5%	54 3%
	Percentage of returns from rind (e – z)	38 5%	45 7%
4	<i>Cost of processing seeds to oil</i>		
	Labour cost (@ 0 5 women day)	10 – 00	10 – 00
	Apportioned labour cost of gathering and up to getting dry seeds (61 5% & 54 3% of Rs 20)	12 – 30	10 – 86
	Total cost of processing seeds to oil (y)	22 – 30	20 – 86
5	<i>Cost of processing wet rind to dry rind</i>		
	Labour cost (@ 0 6 women day)	12 – 00	12 – 00
	cost of fuel-wood (@ 0 70 paise/kg) to dry wet rind	–	29 – 00
	Cost of sugar (@ Rs 15–00 /kg) to prepare squash	90 – 00	–
	Apportioned labour cost of gathering fruits (38 5% & 45 7% of Rs 20–00)	7 – 70	9 – 14
	Total cost of processing wet rind to dry rind/squash (x)	109 – 70	50 – 14
6	Total cost of seed oil and 3 kg of rind	132 – 00	71 – 00
7	Barter price in villages for 1 kg oil	80 – 00	70 – 00
8	Barter price in villages for 1 kg of dry rind	15 – 00	11 – 00
9	Percentage cost per kg of oil (y – b)	24 – 80	37 – 25
10	Percentage cost per kg of dry rind (x – a)	36 – 60	16 – 70

¹Prevailing wage rate is Rs 15+ meals per day, taken to Rs 20–00. A female labourer collects about 10 kg of fruits per day which by weight have 40% wet seeds and 60% wet rind. So from 10 kg of fruits, 4 kg of wet seeds and 6 kg wet rinds are obtained.

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Studies on Fruit Fibre in *Terminalia arjuna*

A.B. Nadaf, A.K. Chougale and L.J. Bhosale

INTRODUCTION

Increasing the yield of raw material/by-products important to human use, from plant wealth, either by natural or artificial means, is one of the most active areas of research. The fibre is an important constituent of human life as it fulfills man's requirements like clothing, shelter, furniture, partition and packing materials, paper, etc., etc. Different plants yield different types of fibres. Further, different types of fibres are yielded by same plant (Hill, 1952). *Terminalia arjuna* is an economically important plant because fuel-wood, charcoal, feed of tasar silkworms and livestock are obtained from it and also contains fruit tannin and leaf fibre.

Sinha *et al.* (1989) and Metcalfe and Chalk (1957) have studied fibres in *Terminalia*. But their studies were confined to leaf fibres only. So here, efforts have been made to study the quality and quantity of fruit fibres and their calorific value.

MATERIALS AND METHODS

The number of fruits/plant of *Terminalia arjuna* were counted by randomly selecting around 100 different plants from Kolhapur City. These fruits were collected as per standard method of Hocking (1993) and their weight was recorded. Weight of the fruit without seed was also recorded. Fruit fibres were observed under microscope and microphotographed.

Fruit fibres were analysed qualitatively by Jeffry's method (Jeffry, 1928) and estimated by method described by Sadasivam and Manikam (1991). Calorific value of fruit material was determined by method of Karzikkın and Tarkovskaya (1964). The experiments were replicated before obtaining average for each parameter.

RESULTS AND DISCUSSION

Number of fruits/plant is around 1000 and weight of fruits is 1.552 kg/plant (Table-1), that is 657 fruits/kg. Hocking (1993) has reported 450 seeds/kg for *Terminalia arjuna*. Differences in fruit weight/kg may be due to different

agroclimatic conditions The weight of fruit without seed is 1.452 kg/plant (Table-1) and this is nothing but weight of fibrous material. The analytical value of this material shows 0.534 kg fibres/plant. This is the value for only fibre

Table-1: Different parameters of fruits of *Terminalia arjuna*

Sr No	Parameters	
1	No of fruits/plant	1000
2	Fruit wt /plant	1 552 kg
		± 0 122
3	Fruit wt without seed/plant	1 452 kg
		± 0 112
4	Estimated fibres/plant	0 534 kg
		± 0 046
5	Fibre length	
	a) Average	1 135 mm
		± 0 364
	b) Maximum	2 109 mm
	c) Minimum	0 666 mm
6	Fibre breadth	
	a) Average	0 025 mm
		± 0 005
	b) Maximum	0 033 mm
	c) Minimum	0 016 mm
7	Calorific value of fibre	1593 cal/gm
		± 10

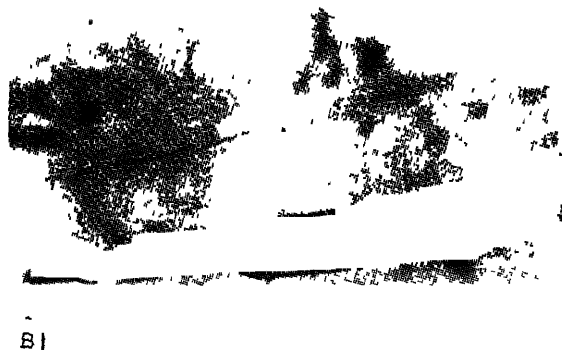
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Average length of fibre is 1.135 mm with maximum value of 2 109 mm and average breadth is 0.025 mm (Plate-1). This fibre is comparable with that of water hyacinth where average length is 1.604 mm and average breadth is 0 055 mm (Thyagarajan, 1983). The hyacinth fibre is used for hand made paper and pulp. Similarly, this fibre can also become good raw material for pulp, paper, etc Attempts have been made to use non-wood fibres of bark, hemp, grasses, rags and agricultural residues like rice straws (EI Ebiary, 1983; Joedodibroto, 1983) Joedodibroto (1983) has reported that grasses are easier to pulp than wood, because of their chemical composition and physical structure This helps in easy processing with less energy and chemicals in smaller mills by using less skilled labour. On this basis, it is expected that fruit fibre of *T. arjuna* can be put to good use. The potential has to be tested

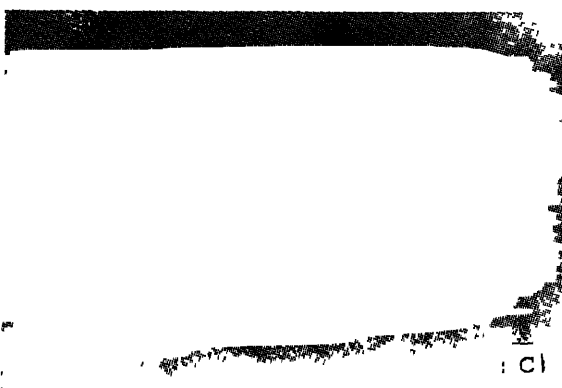
It is attempted to make blocks out of fibrous material, which can be used like coalballs in 'Chulhas' in case of severe scarcity of fuel Alternatively, it can supplement the fuel material The calorific value of fruit fibre is 1593 cal/gm (Table-1) Though the energy potential of this material is low as compared to



x163.8



x787.5



x787.5

Plate 1. Fruit fibres of *Terminalia arjuna*

- A) Group of fibres under low power (x 163.8)
- B) Part of fibre under high power showing constriction (x 787.5)
- C) Part of another fibre showing its apex (x 787.5)

calorific values of woods but not less than the materials being used as fire-wood, (*Indian Forester*, Dec. 1981).

The material for such uses of fruit fibre can be obtained after nicking of the fruit prior to sowing as well as using non-viable seed-covers. Attempts are being made to develop technology for large scale nicking of fruits. It has been reported that nicking of fruits (removing wings) enhances germination. Thus, nicking has dual advantage.

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Need and Opportunities for Managing *Dichrostachys cinerea* (Linn.) Wight & Arn. for Fodder and Fire-wood Production on Wastelands

M.M. Roy and P.S. Pathak

INTRODUCTION

India is predominantly an agricultural country as more than 70% of its population lives in villages and depend mainly on agriculture and animal husbandry. With continued deforestation at the rate of 1.5 million/ha., the country faces serious environmental and socio-economic crisis. Deficit and resultant high cost of fire-wood resulted in burning 60–70 million tonnes of dried cow dung/yr that could have increased food production if diverted to the field. Enormous loss of valuable soil and siltation of soil are the other effects associated with deforestation and these result into floods and droughts, causing 100 million people and million of rupees for relief work.

According to an estimate, by 2000 A.D., country's requirement would be 250 m t of food grains, over 2000 m t of green and dry fodder, 350 m t fire-wood and about 60 million cu m of timber besides amelioration of polluted environment.

The wastelands, especially in dry areas, offer opportunities for economic biomass production for farmers (Gill & Deb Roy, 1992).

Dichrostachys cinerea (Linn.) Wight & Arn. is one of such potential shrub on wasteland situations. At Indian Grassland and Fodder Research Institute, Jhansi it has been extensively studied for its survival, growth and dry matter production in different systems and management regimes, fodder quality of different parts in different seasons and fire-wood potential. The results are being presented in this paper.

SHRUBS FOR FODDER AND FIRE-WOOD PRODUCTION

Shrubs play an important part, in one way or other, in augmenting the grazing values of practically all ranges. Generally, owing to relatively lower palatability than associated grasses, fodder trees and shrubs do not furnish a substantial proportion of forage eaten by cattle and sheep. This may vary from 2 – 30% of

the total forage consumed, depending upon density of browsing, season of growth, availability of species and palatability. In India, use of shrubs together with trees as fodder in some semi-arid and arid zones and hilly regions may constitute as high as 50% of the total forage consumed (Raghvan, 1990)

It is now being realized that importance of shrubs in terms of sustained dry matter yield and high nutritive content has often been overlooked, in spite of the fact that throughout the world, more animals feed on ecosystems in which trees and shrubs play an important part than on true grass or grass legume pastures. A great deal of research has been carried out on grasses and legumes where bush cleaning has been recommended as a practice to optimize pasture yield. However, there is inadequate knowledge about productivity of shrubs. As a result, shrub lands are often mismanaged, under-utilized, degraded or depleted (Ibrahim, 1988)

Recent studies (Upadhyay & Ramachandra, 1990) reported that in many shrubs on the degraded grazing lands, where for longer part of the year, animals depend upon it, the CP was found to be always more than 11% thus providing high nutrition. It is, therefore, felt that desirable shrubs should not only be retained but needed to augment production and assure conservation. This is considered more desirable when we plan the small ruminant production.

To meet the demand for food in developing countries, agriculture and livestock production need to be more than doubled. Thus for meeting the demand for growing livestock population in India, especially the small ruminants, there is great and still untapped potential from shrubs. Also, these can contribute towards growing fire-wood requirements.

Such species can be grown on low productive lands due to physical limitations such as low and erratic rainfall, poor soils, rough topography, short growing seasons, inaccessibility, etc., which make them unsuitable for cultivation.

These have great potential to improve the quality of such wastelands besides being a potential source of feed resources during dry seasons and prolonged drought periods (Torres, 1983)

THE SPECIES

Dichrostachys cinerea Wight & Arn (Syn. *D. glomerata*, *D. nutans*, *Mimosa cinerea*) is a thorny shrub or small tree widespread in tropical Africa, Iran, tropical Asia and Australia. In India, it occurs in dry scrub forests and arid hills of north west and central India (Anonymous, 1952)

The stem is used for making walking sticks and tent pegs besides being used as fire-wood. The leaves and pods are used as fodder, leaves, particularly relished by camels and pods by cattle (Skerman, 1977). Chemical composition of leaves and pods of the species is shown in Table-1

Table-1: Chemical composition of leaves and pods of *D. cinerea*

Composition	Leaves (%)	Pods (%)
Crude protein	15.23	11.40
Crude fat	1.23	1.20
Crude fibre	28.09	25.60
Nitrogen free extract	50.46	56.40
Ash	4.59	5.50
Calcium	-----	-----
Phosphorus	-----	0.20

(Source: West, 1950, Wilson & Bredon, 1963)

The species is quite suitable for soil conservation and afforestation programmes on highly degraded lands. The species has an ability to propagate through root suckers. The branchlets of the species are armed with sharp woody spines and, therefore, it can be used around cattle proof trenches along with other species (Roy *et al.*, 1987).

STUDY SITES

At Indian Grassland and Fodder Research Institute, Jhansi the species has been extensively studied at five sites, of which four sites are located within the institute and one site is located at Dhirpura (MP). Site-I represents wasteland with sandy, clay loam texture and shallow top soil. Site-II represents a typical ravine situation having high pH. Site-III and IV have very shallow top soil. The soil is mainly red murrumy with semi-rocky substratum at places. The physical and chemical characteristics of these soils are presented in Table-2.

Table-2: Physical and chemical characteristics of soils at the study sites

Site	Soil Texture				Soil Nutrients			
	Sand (%)	Silt (%)	Clay (%)	pH	Available nutrients (kg/ha)			
					Org Carbon (%)	N	P	K
I	55.2	16.7	31.1	6.6	0.34	165.0	7.14	156.0
II	-----	-----	-----	8.8	0.21	119.0	3.58	-----
III	31.7	24.6	43.7	6.7	0.35	167.0	7.39	224.0
IV	42.0	31.6	26.4	7.0	0.28	157.0	3.01	168.0
V	25.0	31.6	43.4	6.8	0.41	283.3	9.07	252.0

D. cinerea seedlings of 0.8–1.0 m height were planted in 30 cu cm pits. Application of FYM (10 kg with soil in pit) before planting and 50 g basal dose of NPK/pit (10:20:20) after two weeks of planting, in the basin around the plant, was done. In silvipastoral experiments, pasture grass was transplanted in

between the shrub interspace at 50 × 50 cm. The pasture legume seed was broadcasted @ 5 kg seed/ha. In the first year, these plots were fertilized with 40 kg N, 60 kg P and 20 kg K/ha. In the subsequent years only 20 kg N/ha was applied

SURVIVAL AND GROWTH ON WASTELANDS

The survival of the species, in different sites, compiled from various sources is presented in Table-3

Table-3: Survival of *D. cinerea* on different sites during 3rd year (average values)

Site	Survival (%)
I	76.3
II	84.9
III	86.7
IV	82.7
V	90.2

(Source: Singh *et al.*, 1986, Roy *et al.*, 1987, IIRP, 1990)

In terms of survival, the species has shown excellent response (76.3–90.2% survival at third year). On most infertile soils, the response has been over 85%. This clearly establishes its potential on degraded lands and wastelands.

The growth in height and collar diameter (cd) is presented in Table-4. It is compiled from various sources.

Table-4: Growth of *D. cinerea* on different sites

Site	Age (in yrs)	Growth Height (in cm)	Collar Diameter (in cm)
I	3	106.7	1.82
II	3	79.5	1.37
	9	222.0	3.55
III	6	280.0	4.20
IV	5	221.0	3.68
	7	312.3	5.16
V	6	350.0	8.20

(Source: Singh *et al.*, 1986, Roy *et al.*, 1987, IIRP, 1990)

On comparatively better sites (site-V), the species has shown more growth than other comparable sites. In extremely difficult situation (site-II) the growth rate is comparatively poor. The trend in both the growth parameters in a given site is quite consistent, indicating site effect on growth.

BIOMASS POTENTIAL

The biomass potential of the species on degraded lands is quite high because of high survival rates. On calcareous wastelands (site-IV) the biomass production increased consistently with the increase in plant density. Most appreciable difference is found beyond plant density of 1000 trees/ha (Table 5)

Table-5: Above ground biomass production from *D cinerea* on calcareous wastelands (at 7 years)

Plant Density	Biomass (DM in t/ha)				
	Leaf	Stem	Pod	Seed	Total
625	2.37	15.48	4.44	1.76	24.05
825	2.80	19.43	5.57	2.06	29.86
1000	3.10	22.64	6.50	2.41	34.65
1650	4.62	33.70	9.05	3.43	50.80
2500	6.50	39.72	8.82	3.45	58.54

While proportion of leaf in total biomass has shown increasing trend with increased plant density, proportion of pod in total biomass exhibited a decreasing trend. However, the contribution of leaf through sucker part generally decreased with increasing plant density (Table-6)

Table-6: Contribution (%) of root suckers in above ground biomass production of *D cinerea* on calcareous wastelands (at 7 years)

Plant Density	Leaf	Stem	Total
625	6.15	28.06	34.21
825	5.73	21.53	27.26
1000	4.90	16.42	21.32
1650	5.09	3.91	18.18
2500	3.67	6.57	10.24

In an evaluation trial of pasture suitability with this species on calcareous wastelands (site-IV), it was found that *Cenchrus ciliaris* and *Stylosanthes hamata* combination provided peak forage yield (3.84 t/ha) followed by *C ciliaris* alone (3.11 t/ha) (Table-7)

MANAGEMENT FROM UTILIZATION VIEW POINT

In an evaluation of various tree management practices, viz., coppicing, pollarding and lopping practices on this species, it was found that species respond fairly well to coppicing and lopping management. On site-V, where detailed coppice studies were taken, it was found that two year old coppice shoots can yield substantial amount of fodder (Table-8)

Table-7: Pasture production from different *D. cinerea* (1650 plants/ha) based silvipastures on calcareous wastelands (average data of first 3 years)

Pasture Combination	Pasture Yield (DM in t/ha)
<i>Cenchrus ciliaris</i>	3.11
<i>Cenchrus ciliaris</i> + <i>Stylosanthes hamata</i>	3.84
<i>Cenchrus ciliaris</i> + <i>Macroptelium atropurpureum</i>	2.96
<i>Chrysopogon fulvus</i>	2.47
<i>Chrysopogon fulvus</i> + <i>Stylosanthes hamata</i>	2.96
<i>Chrysopogon fulvus</i> + <i>Macroptelium atropurpureum</i>	1.92
<i>Stylosanthes hamata</i>	1.32
<i>Macroptelium atropurpureum</i>	0.98
CD at 5%	0.62

Table-8: Fodder and fuel production through coppice management in 6-yr -old *D. cinerea* (site-V 625 plants/ha)

(average of 2 year data)

Height of main coppice shoot (m)	162.00
Diameter of main coppice shoot (cm)	1.20
Fodder production (DM in t/ha)	0.84
Fire-wood production (DM in t/ha)	3.30
L/S ratio before coppicing	0.11
L/S ratio after coppicing	0.23
Crude protein (%)	13.50

On site-III, where detailed lopping studies were taken, it was found that on an average 3.64 t/ha /yr DM may be obtained through lopping management after five years of growth (Table-9)

Table-9: Fodder and fire-wood production through lopping management of 5-yr -old *D. cinerea* on site-III

(DM in t/ha /yr)

Plant Density	Main Plant			Root Sucker		
	Fodder	Fire-wood	Total	Fodder	Fire-wood	Total
625	0.34	0.46	0.80	0.45	2.95	2.50
825	0.62	0.98	1.60	0.38	1.52	1.90
1000	0.68	1.32	2.00	0.40	1.40	1.80
1650	0.85	1.75	2.60	0.50	0.85	1.35

(Source Roy & Choubey, 1993)

The lopped yields from main trees were higher in higher plant densities whereas sucker yield were higher in lower plant densities. The lopped L/S ratio was found to be higher in main plant as compared to sucker material.

FODDER QUALITY

The species has been studied for fodder quality in different seasons by Majumdar *et al.* (1987). During winter (November–March) and summer (May–June) the plant has high DM content (37.9–41.1%). The crude protein values are high during July and December (14.9%) and April (15.1%). Fibrous fractions are low in summer and winter months. Similarly, hemicellulose content is low during the period November–December and then during May–June. Thus, in this species the most active period, from fodder quality viewpoint, is during April–June followed by November–January.

At CIRG, Makhdoom, Sharma *et al.* (1990) reported this feed (leaf + tender twigs) to be rich in CP (13.13%) NDF (74.29%) and lignin (10.89%). The voluntary uptake of DM, DCP and TDN was 90.40, 5.72 and 59.12 g/kg w 0.75 respectively in case of 'Barbari' goats.

Based on their findings, they suggested that this feed could serve as a sole feed for maintaining goats in semi-arid areas.

In a study on antiquality constituents in foliage of this species, Bhadoria & Garg (1992) reported low tannin content, least being in July (1.25%). Leaves are reported to be free from saponins, alkaloids, cyanogenic glucosides and lactones.

FIRE-WOOD PRODUCTION

Shrubs may play an important role in mitigating growing fire-wood scarcity also. After utilizing leaves, tender twigs and pods for fodder, the remaining part of the species are sun dried and used for fire-wood. On complete harvest (7-yr.-rotation) DM yield level of 2.2 – 5.7 t/ha/yr may be obtained depending on site, plant density and type of management.

In tree based silvipastoral systems, the species can be used as a middle storey providing additional fodder and fire-wood at regular intervals and thus improving the land productivity and sustainability. Such meaningful 3-tier agroforestry on wastelands having this species with *Leucaena leucocephala* + *Cenchrus ciliaris* (Singh & Bhattacharya, 1987) and *L. leucocephala* + natural pastures have been demonstrated (IIRP, 1992). In shrub based silvipastoral systems, the species can be managed in a way so that interspace between the plants could be used for raising palatable pasture grasses and legumes. Pasture yield of 2.96–3.11 t DM/ha from highly degraded lands together with average biomass of 7.14 t DM/ha/yr from *D. cinerea* makes such systems (7-yr.-rotation) highly

productive from fodder and fire-wood viewpoint. This production level is quite high against the current production level of unmanaged degraded lands (1 t DM/ha /yr).

CONCLUSION

Based on the above presentation, it may be concluded that the species has enormous potential in different wasteland situations because of its ability to survive, especially in semi-arid and arid regions, where most other trees and shrubs find it difficult to survive with low inputs.

By scientific management of this species on wastelands, additional biomass of 3.3–8.3 t/ha /yr may be obtained depending on the site and type of management. It has the potential to supply 0.79–1.30 t/ha /yr. fodder or 0.11 – 0.37 t CP/ha /yr, depending upon the site and type of management. Thus, there is a great potential of this species in meeting fodder and fire-wood requirement from wastelands.

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Tasar Culture – Gap in Potential and Production

M.K. Jha, T. Babu and S.S. Sinha

INTRODUCTION

Tasar is a silk produced by certain species of sericigenous insects belonging to the genus *Antheraea*. Depending on the insect species, place of origin, and its food plants, tasar in India is broadly classified into two categories:

Tropical Tasar

It is one of the important non-timber forest produce (NTFP) found in tropical forests of the country. It is collected in the form of silk cocoons spun by the polyphagous insect *Antheraea mylitta* feeding on leaves of *Terminalia tomentosa* (Asan), *Shorea robusta* (Sal), *Zizyphus mauritiana* (Ber), and *Lagerstroemia parviflora* (Sidha), etc. It thrives as a part of traditional means of livelihood amongst the aboriginals of Bihar, Madhya Pradesh, Orissa, West Bengal, U P, Maharashtra and Andhra Pradesh. Of late, with the advent of novel research findings, it is being reared on the bushes of *T. arjuna* in an organised manner.

Temperate Tasar

It is a recent introduction in India as an outcome of successful hybridization between *Antheraea pernyi* and *A. roylei*. The new species so obtained is known as *A. proylei*. It feeds on the leaves of Oak plants, (*Quercus incana*, *Q. serrata*, *Q. dealbata*, *Q. semecarpifolia*, *Q. himalayana*, etc.). The Oak flora is abundant in the country occupying substantial part of forests in the Sub-Himalayan region, i.e., Manipur, Nagaland, Mizoram and Arunachal Pradesh in North-East, as also in Himachal Pradesh, Jammu & Kashmir and Uttar Pradesh hills in West. The temperate tasar commonly called as 'Oak Tasar' has a high potential for ecofriendly use of Oak plants in the region, however, the rearing practices are now in the process of stabilization.

The scope of this paper is confined to the tropical tasar only.

POTENTIAL

The tasar culture has huge potential in terms of utilization of existing insect

faunas, food-plant floras as well as reclamation and development of wasteland. It provides a renewable resource base for employment generation and socio-economic development in rural areas besides foreign exchange earnings.

FOOD PLANT AVAILABILITY

It has been estimated that tasar food plants exist in 11.2 million hectares in India. Of this, nearly 87% (9.7 million hectares) has *Shorea robusta*, rest is occupied by *Terminalia* spp. and other food plants (Fig. 1). Presently, only a small fraction of this, that too limited to *Terminalia tomentosa* and *T. arjuna* is used for the purpose of tasar rearing. The use of Sal flora for tasar rearing is confined to the perpetuation of this insect species in nature only. The reason attributed to it is the poor survival of worms on Sal, resulting into low ERR % (Effective Rate of Rearing). The worms when fed with Sal leaves in farm managed conditions meet a heavy toll. However nature grown cocoons on Sal are collected from the woods of Bastar region in Madhya Pradesh and Simlipal in Orissa.

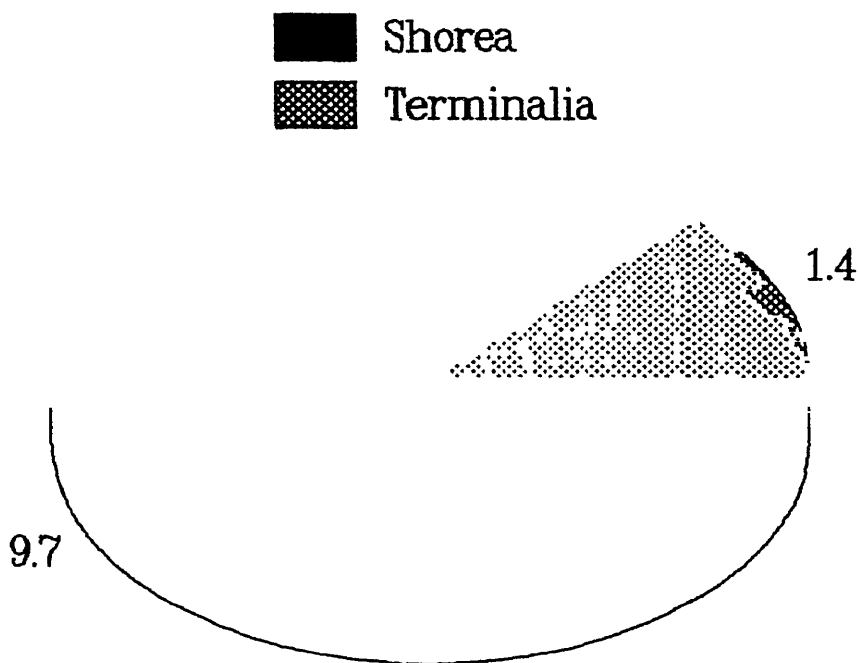


Fig 1. Food Plant Potential of Tasar in Tropical Forests of India (Figures are in Million Hectares)

TASAR SILKWORM FAUNA

The tasar silkworm is highly heterogeneous. It has established itself in various forms of ecological populations (commonly called as ecorace), in different geographical niches of the country, depending upon food plants and micro-environmental conditions available to them. The cocoons of these ecoraces differ in their technological qualities, silk richness and biological behaviour (Table-1). The efforts made to stabilise and popularise commercial rearing of the races having superior qualities and their hybridisation to exploit heterosis have ushered in a new era in the wild silkmoth's harnessing.

Table-1: Commercial characters of some important races of *A. mylitta* in nature

Race	Fecundity (Avg)	Cocoon (g)	wt (g)	Shell (g)	wt (%)	Ratio	Filament length (mt)	Denier
Daba	250	12.10		2.80	12.64		750	12
Laria	215	9.75		1.88	19.28		785	10
Sarihan	201	6.89		0.71	10.20		533	9
Bhandara	195	6.93		1.24	17.89		613	9
Nega	180	7.74		1.23	15.89		819	8
Bogai	210	9.42		1.45	16.34		895	9
Jedai	170	12.29		2.23	18.14		993	12
Moonga	168	7.73		1.24	16.04		834	9
Nowgaon	165	8.60		1.24	14.30		475	10
A Local	119	9.45		1.57	16.61		700	10
Nahia	182	11.68		2.57	22.00		1201	12
Railly	280	12.77		2.66	20.83		1232	13
Mugia	182	11.11		2.37	21.33		1239	11
Mirzapur	175	8.14		1.64	20.14		800	11
Barharwa	166	13.76		3.01	21.87		1234	10
Sukinda	266	13.00		1.80	13.58		845	10
Moddia	190	15.29		3.17	20.73		1234	12
Modal	249	14.17		3.64	25.68		1383	12
Patjharia	200	7.32		0.94	12.84		895	9
Jarai	195	6.37		1.10	17.26		600	9
Munga	185	6.86		0.84	12.97		550	10
Jiribam	152	11.31		2.54	22.44		950	10
Belgaum	160	6.38		0.54	8.46		617	8

PRODUCTION STAGES

The tasar industry as a whole consists of a series of relatively independent

activities knitted together by different market structures. Production is divided into two distinct stages, i.e., rearing of silkworms and post-cocoon processing including weaving. The former is a forest-based activity whereas the latter is a popular cottage-based industry.

Rearing of cocoons in open forests primarily on Asan trees. (*T. tomentosa*) is vogue amongst the adivasis residing in and around the forests. It involves:

- i) procurement of seed cocoons either from the forest or from the market,
- ii) traditional grainage operations to get eggs from the tasar moths,
- iii) obtaining permission from the Forest Department for rearing in forests,
- iv) clearing operations around the host trees to facilitate, watch and ward against pest and predators,
- v) putting the eggs on the plant in a leaf cup for hatching and onward rearing,
- vi) care of the larvae until cocoons are formed, and
- viii) harvesting and storing of cocoons.

The cocoons, as end product of rearing are sold in the market for breeding or reeling.

LIFE CYCLE

The insect is bi-voltine completing two generations in a year. However, in warmer climates, part of the population turns to be tri-voltine. The average larval period during first, second and third crops is around 30, 45 and 65 days respectively. The winter crop harvested cocoons enter into diapause and emerge as moths giving rise to first crop during the monsoon next year which coincides with the sprouting of leaves in the host trees. The life cycle passes through four stages, egg, larval, pupa and adult (Fig. 2). The larvae are tetramoulters. Cocoons are the end product of rearing. Out of four stages, the eggs enclose the embryonic development and larva is the feeding stage. The adult moths which are non-feeding emerge only for the purpose of reproduction. Pupa remains in dormant stage to tide over the unfavourable climatic conditions. A process called histogenesis takes place inside the pupa in which genesis of reproductive organs and lysis of digestive organs occur. Pupa is covered inside a cocoon shell.

The cocoons are purchased by the traders, entrepreneurs who distribute it to individual families who reel the yarn and weave tasar fabrics and their blends, as wage earners.

SOCIO-ECONOMIC PROFILE

The persons associated with tasar rearing mainly belong to the weaker sections of the society. Most of them are aboriginals belonging to tribal communities like Santhal, Oraon, Munda, Ho, etc. Presently 1.32 lakh families are engaged

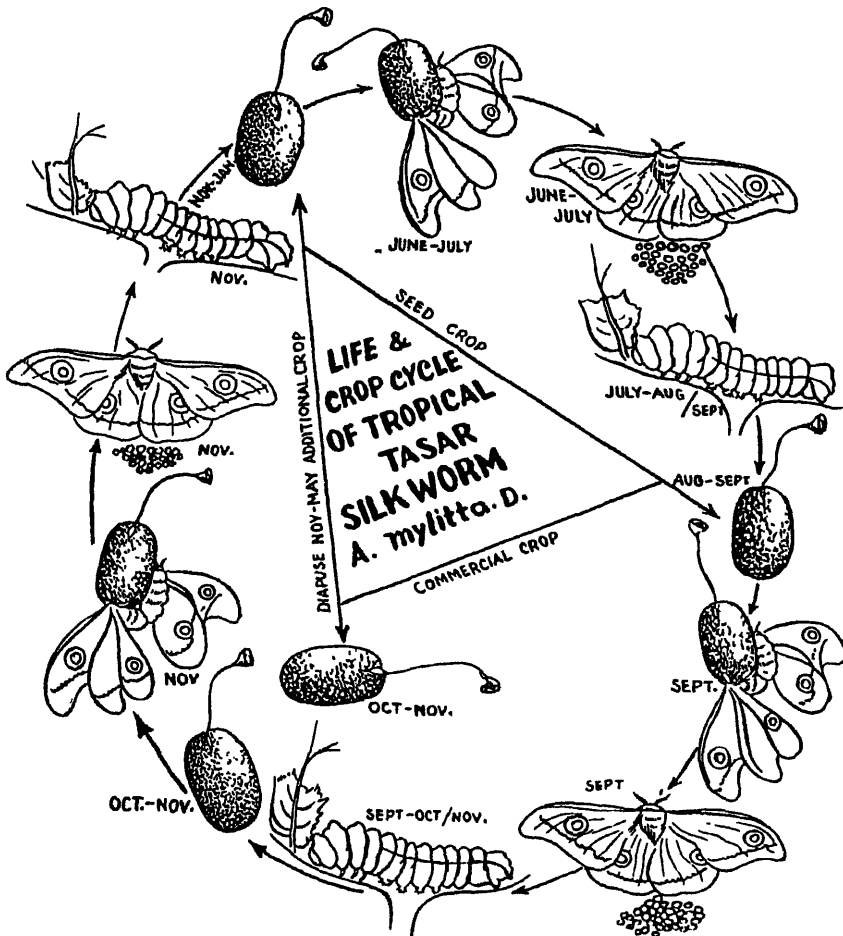


Fig. 2:

in tasar production in the country. Tasar rearing is a part of their life and culture. Figure 3 shows the position of different groups in tasar rearing in major states of its production.

PRESENT SCENARIO

The production of tasar silk in the country has more or less stagnated during the recent years. Figure 4 shows the trend of production for the period 1971-1990. The latest production figures for the year, 1992-93 and 1993-94 in terms of production of disease-free layings (Dfls.), reelable cocoons, raw silk and silk has been illustrated in Fig. 5.

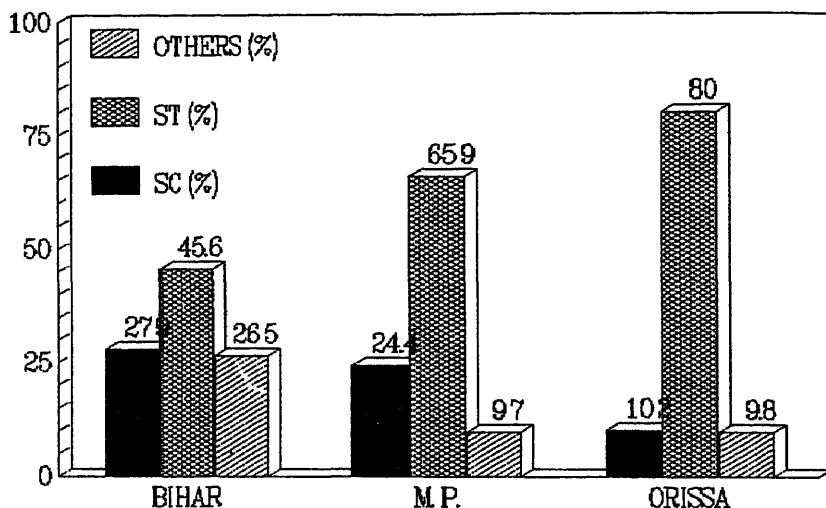


Fig. 3: Employment in Major Tasar Producing States

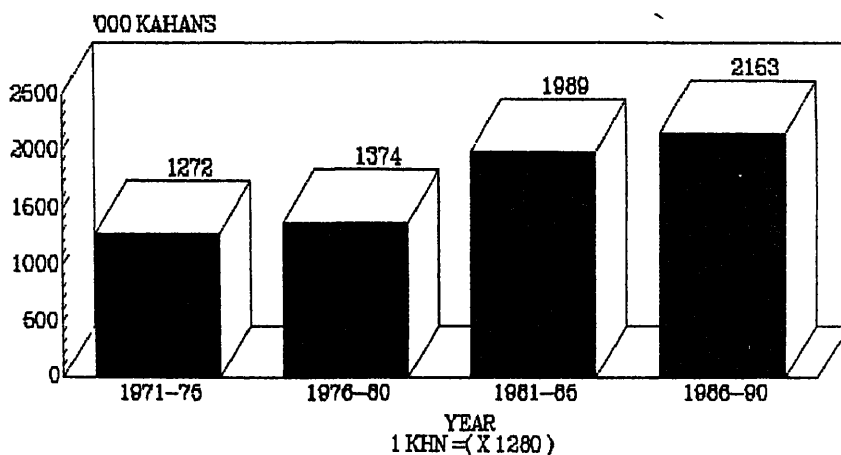


Fig. 4: Tasar Cocoon Production in India

The stagnation, however, needs to be studied and remedied in the light of following

- i) the nature of the industry which is traditional and trader oriented, is inherently incapable of mounting long ranging development efforts,
- ii) priority of tasar within the overall policy framework for silk development,
- iii) geographic location of the traditional tasar belt which lies in the relatively less developed states and regions,

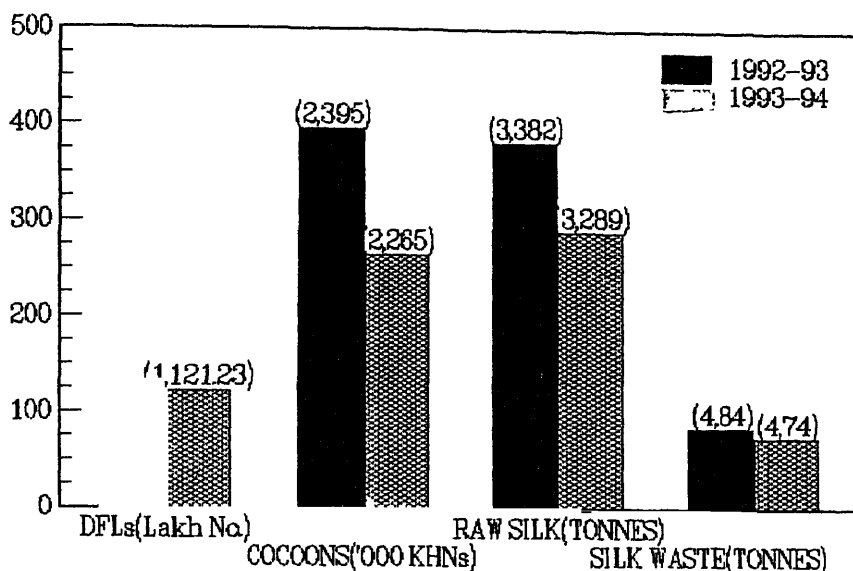


Fig 5: Tasar Production

- iv) longer gestation period of tasar plantations,
- v) inadequate development and service infrastructure which inhibits private initiative for raising plantations, and
- vi) the profile of the primary producers; the adivasis who are among the poorest people, and their inability to muster the necessary policy intervention and entrepreneurship

THE CENTRAL TASAR RESEARCH AND TRAINING INSTITUTE (CTR&TI), RANCHI — ACHIEVEMENTS — AN OVERVIEW

The CTR&TI, an organisation of the Central Silk Board (CSB), Ministry of Textiles, Govt. of India, is responsible for extending research and development support to the tasar industry. Its activities span across four functional areas: research, training, multiplication of seed and extension of technologies developed.

Although, tasar cultivation is still largely traditional till date, CTR&TI has developed more systematic and modern practices for tasar silkworm rearing. These consist of a combination of plantation, grainage and rearing techniques. A comparison of the two practices is given in Table-2.

Plantations of host plants are raised by transplanting seedlings. They are ideally raised in compact and contiguous blocks to facilitate rearing. The host plants are pruned and pollarded periodically to form bushes with a low, inter-lacing canopy. Under these conditions, the tasar worms can crawl onto

Table-2: Traditional and Modern Practices of Tasar Rearing

Particulars	Traditional Method	Modern Method
Land Requirement	None Rearing done on trees in forest or on field bunds	Needed in compact blocks for raising plantations
Host Plant	Asan, Arjun and Sal	Arjun and Asan
Plantation Techniques and Management	Dispersed trees in forests and farm bunds, unplanned pollarding and pruning, leaf yield high per tree but low per hectare	Dense bush plantations raised from seedlings, scientific pruning and agronomic practices, leaf yield low per bush but high per hectare
Rearing Capacity	100 layings per family, dispersed and tall trees hamper watch and ward	400 Dfls per family, watch and ward easy with dense, low and interlaced
Features	Worms have to be moved manually between trees, losses are high due to frequent handling, fall from trees and pests and predators	Canopy, less handling of worms which crawl across bushes, losses are low
Egg Preparation	At home, from cocoons kept from previous crops, layings not checked for diseases, eggs not disinfected, no infrastructure needed 7 to 10 cocoons needed per laying	In Grainages, from seed cocoons, layings tested microscopically and diseased eggs destroyed, eggs disinfected Infrastructure and supplies needed, about 4 to 5 cocoons needed per Dfl
Rearing Practices	Eggs mounted outdoors in leaf cups tied to trees, high, early loss due to wind and rains	Eggs hatched indoors and worms reared indoors for 72 hours, then outdoors, critical initial wastage minimized
Yield	20-25 cocoons per Dfl	45-50 cocoons per Dfl
Labour Input	High per cocoon	Low per cocoon

adjoining bushes on their own, when leaves of one bush are exhausted. Inspection of worms, removal of diseased ones, manual transfer of larvae, pest control and harvesting of cocoons are much easier for the interlaced canopy of the host trees. Productivity of land can be managed through conservation measures, intercultural operations and application of manure and fertilizers. Compact rearing area makes watch and ward feasible and easier.

To ensure high productivity and low mortality, layings (eggs of the tasar moth) are prepared under salubrious conditions from cocoons especially selected for the purpose. The eggs, thus obtained are disinfected. Diseased layings, detected during microscopical tests, are removed and destroyed. The worms hatched out of disease free layings (Dfls) are preferably mounted indoors on fresh loppings of *Terminalia* trees for the first 72 hours. This minimises losses owing to weather hazards.

The new grainage technology and rearing practices guards against wastage of seed cocoons, loss of growing stock, the risk of diseases and epidemics among

worms, while simultaneously increasing the productivity of land with economization of labour and other material inputs

The CTR&TI's package of raising dense plantations, intensive cocoon rearing and use of Dfls. would substantially reduce silkworm losses from the vagaries of nature. Wastage would be reduced at each stage of the rearing process. Hence, productivity would be higher, making tasar rearing more profitable

CONSTRAINTS AND GAPS

The profitability of the modern package of practices for tasar rearing should however be weighed against the constraints or shortcomings, especially from the view point of an individual rearer's household. These are .

- i) the modern package to be effectively implemented requires fallow or wasteland in compact blocks for establishing *Terminalia* plantations. Poor people may not own or have control over such land,
- ii) technical inputs, for establishment of nurseries and plantation require fair amount of expertise to make the culture economically viable. Extension programme to provide such support systems do not exist,
- iii) the modern package is, relatively, a high investment and high stake venture in contrast to the traditional practices. The latter requires no capital investment and the rearer has only two months' (otherwise idle) labour at stake and remains satisfied even with poor returns,
- iv) reliable linkages and infrastructure, such as grainages for supplying dfls, assistance in disease and pest control to ensure sustained high factor productivity at the rearing stage and marketing channels to ensure remunerative prices for the cocoons do not yet exist, though both are essential for viability, and
- v) financial packages tailored to the needs of potential adivasi rearers have not been promoted.

The Modern Package can therefore be introduced effectively only if

- i) village clusters are identified where adivasis own adequate wasteland in a compact area (or public wasteland can be leased to them) for raising *Terminalia* plantations so that inputs and services can be provided in a cost effective way,
- ii) financial packages suited to tasar cultivation are made available to the adivasis for establishing the plantations,
- iii) infrastructure and organisation are created to provide the required extension input support, and
- iv) appropriate organisation is fostered to promote marketing of end product to ensure adequate returns to the participating rearers, free of exploitation

RESEARCH PRIORITIES AND POLICY INTERVENTIONS

The preceding account reveals that in spite of significant indigenous advances in technology development, traditional technology continues to dominate the industry and tasar culture thrives as a dispersed forest based activity providing only subsidiary occupation to the adivasis. Following are the important segments of priority in research and intervention in tasar culture

Promotion and Protection of Tasar Food Plants

The tasar food floras have been depleting fast. Further, the available Sal flora (secondary food plants) remains under-utilized due to biological reasons or otherwise. Therefore, it is of utmost importance that in tasar growing regions, forests are protected under a community managed system with special emphasis on adoption of tasar culture by the villagers. For the purpose, usufruct rights for the use of required patches of forests are provided in the form of 'patta'.

Further, policy decision for developing at least 20% of the degraded wasteland in the plateau regions were taken and implemented for plantation with tasar food plants. The non-governmental organisations may be encouraged to undertake this work. Technical and financial support for the purpose may be extended on easy terms. Since the gestation period required for maturation of the tasar food plants is relatively long, the land husbandry work combined with inter-cropping of selected, edible fodder crops can be encouraged along with tasar plantation. Research efforts may be designed and directed to propagate tasar seedlings / plantlets of desired variety on large scale, either through tissue culture or otherwise.

Grainage Technology

Grainage technology deals with reproduction of tasar insect and production of tasar silkworm seeds. The research efforts made so far have made it possible to conduct the grainage operations under scientific manoeuvring. The requirements for an effective grainage are known, however, the information available on reproductive physiology is limited. Therefore, reproductive physiology should find its place in the research agenda on priority.

Rearing

The rearing of tasar worms still continues in a sporadic manner. Being dependent on nature, cocoon production is greatly influenced by weather hazards, pests and predators. Further, quality of leaves also determines the quality of rearing. Hence the other priority item of research in tasar culture is rearing technology with emphasis on nutritional physiology.

Extension Services, Manpower Development and Management of Rearing Practices

These are important arenas in terms of tasar culture, though they require to be duly accentuated. Research findings have reached a level so as to be absorbed by the beneficiaries through standard management practices relevant to this age-old craft. The HRD in tasar sector is required to match befittingly the R & D achievements through well conceived programmes of extension management.

Marketing

The cocoon market is dominated by traders, entrepreneurs. This appropriates bulk of 'value-addition' in their favour. It leaves little room for securing due dividend by the actual producers. Also, the regular import of raw silk needs to be reviewed in terms of the interest of the primary producers of the country. Government interventions in cocoon trade though has been there, its impact by and large is yet to be appreciated by the producers. In a nutshell, the tasar industry is one of the many under-exploited forest based rural livelihood avenues. The impetus for expanding the production base is unlikely to come from within the trade. In order to fully exploit the livelihood opportunities in favour of weaker sections through tasar culture, available in tasar, it is important to promote

- i) new occupations like raising of tasar host plants on wasteland owned and controlled by villagers,
- ii) capital investments to expand the production base,
- iii) appropriate extension and service infrastructure,
- iv) "business" know how, entrepreneurship and corresponding organisations so as to enable the traditional producers to deal effectively with the market, and
- v) matching R & D support.

Incidence of Lepidopterous Pest on Primary Tasar Food Plants

R.N.Singh, P. Karnan, V.N. Bardiyar and S.S. Sinha

INTRODUCTION

Pest management cannot operate without accurate estimates of pests and densities of natural enemy population. Pradhan (1971) emphasised the need for intensive studies on the life history of each insect pest and its natural enemies. These studies are bound to be costly and time consuming. Yet, there are no alternatives, and in their absence, the concept of Integrated Pest Management can never be operationalised. Every effort is being made to raise the production of silk by modern sericultural practices such as use of high yielding races, improved plantation techniques and assured rearing technology in order to meet growing demand of silk. These composite efforts are however nullified if the food plants of silkworm are not protected from the ravages of pest insects.

Primary tasar food plants (*Terminalia arjuna* and *T. tomentosa*) are attacked by number of insect pests (Singh, 1989). Of the pest insects, lepidopterous defoliators alone cause 40-45 per cent damage (Singh *et al*, 1991). Lepidopteran defoliation damage can be recognized readily by the absence of foliage or from uneaten leaf parts such as petioles, midribs or other remaining portion of the leaf blade. Several workers have reported the incidence of lepidopterous pests on a number of plants and crops (Anderson, 1960, Boer, 1970, Gupta, 1972, Haukioja, 1990, Ohmart *et al*, 1984, Jeffords and Hayer, 1988, Shore and Alfaro, 1988, Williams *et al*, 1991; and Zanuncia *et al*, 1992) but very little is known about the population regulations, numerical dominance and successive preferential distribution of lepidopterous pests associated with the primary tasar food plants (Singh, 1989, Singh and Bhengara, 1990; Singh and Thangavelu, 1993b).

The ecological approach to the pest-management suggests the use of pesticides only when and where necessary. It has become, therefore, absolutely imperative that a fresh approach to pest control be undertaken by studying the incidence of lepidopterous pests on tasar food plants in relation to the abiotic parameters of environment. This study will provide an opportunity to face the pest challenge by manipulating the manageable ecological parameters, both abiotic and biotic in the form of rearing or cocoon harvesting, time adjustment, correct timing of pesticidal application besides other management practices.

MATERIAL AND METHODS

Field experiments were planned and conducted at the farm of Central Tasar Research and Training Institute, Ranchi, to determine the influence of abiotic factors (meteorological parameters) on incidence of lepidopterous defoliators of primary tasar food plants (*T. arjuna* and *T. tomentosa*) during 1992 and 1993. Population counts of insects were done as suggested by Singh and Thangavelu (1992a).

Meteorological parameters, viz, temperature, relative humidity and rainfall were recorded *in situ* during the period of study to determine their effects on pest incidence (Figs. 1 and 2). For establishing the relationship of abiotic factors and the pest incidence, the graphical, super imposition technique by graph-in box through computer was employed.

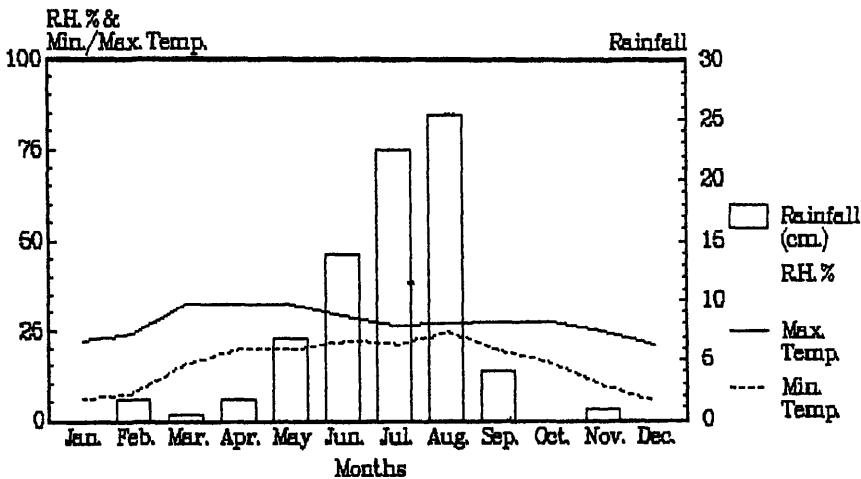


Fig 1: Meteorological data of Ranchi (C T R & T I) during 1992

RESULTS AND DISCUSSION

Twenty five insects of different groups appeared in succession at different stages of primary tasar food plants (Table-1). The pest appears during sprouting stage and its population continues to build up throughout the fresh crown. Incidence of major insects associated with the primary tasar food plants (*T. arjuna* and *T. tomentosa*) is depicted in Figs 3 and 4. Noctuid, lymantrid, geometrid, lymantrid and pyralid larvae feed on the leaves and cause maximum damage. Of these, some key pests have been studied for their biology and

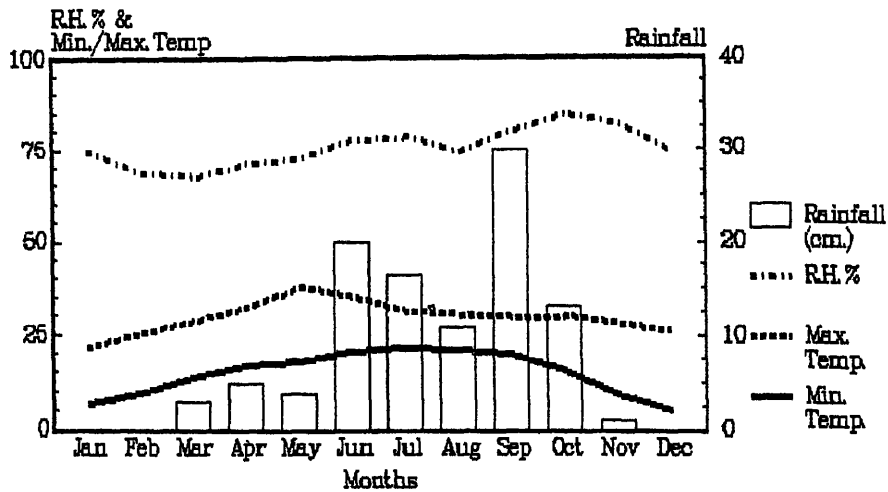


Fig. 2: Meteorological data of Ranchi (C T R&T I) during 1993

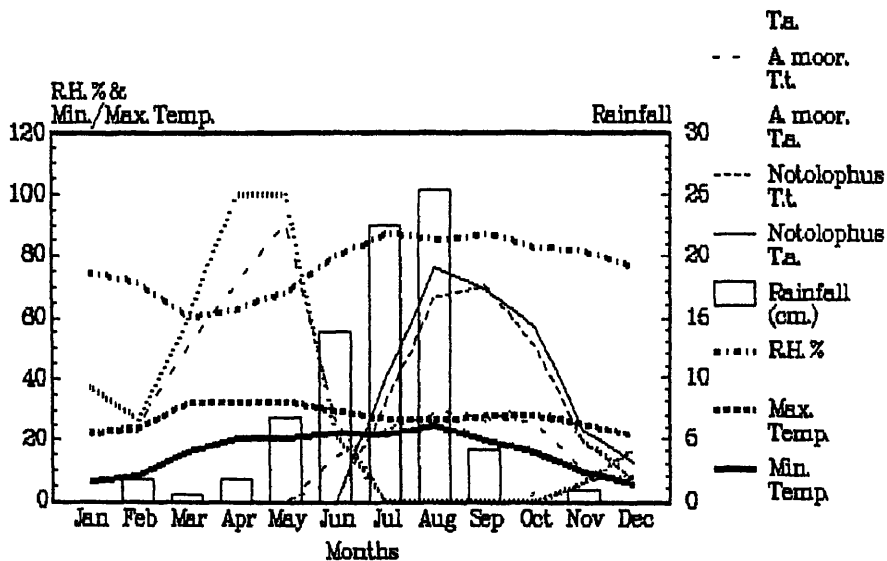


Fig. 3: Pest complex of primary tasar food plants during 1992

behaviour (Singh and Thangavelu, 1992a). Population build up of any insect pest is very intimately associated with weather conditions prevailing. The

Table-1: Important lepidopterous pests of primary tasar food plants

Insect Name	Pest status	Season of occurrence	Susceptible stage
Noctuidae			
<i>Plutella maculipennis</i> Mo	+++	Winter, Spring	All larval instar
<i>Carya subtilella</i> Wlk	++	Winter	I-III larval instar
<i>Hyblaea purera</i> Cran	++	Spring	I-V larval instar
Lymantriidae			
<i>Euproctis lunata</i> Wlk	+++	All seasons	All larval instar
<i>Notolophus antiqua</i> Linn	+++	All seasons	Egg and early larval instar
<i>Hemerocampa leucostigma</i> Abbot & Smith	+++	All seasons	Egg and early larval instar
<i>Thaenidia postica</i> Wlk	++	Spring	All larval instar
<i>Dasychnia horsfieldi</i> Saund	+++	Rainy season	All larval instar
Tortricidae			
<i>Eucelina crinita</i> Meyr	+++	Spring	I-III larval instar
<i>Laspeyresia pseudonectis</i> Meyr	+++	Spring	Adult
Tineidae			
<i>Depressaria ricini</i> St	+++	Late summer	I-Vth larval instar
<i>Acrocercops (Gracilaria) terminaliae</i> Stn	++	Late summer	I-Vth larval instar
<i>Gracilaria octopuncta</i> Meyr	+	Late summer	All larval instar
Geometridae			
<i>Macaria fasciata</i> Fabr	++	Spring	All larval instar
<i>Thalassodes quadraria</i> Guen	++	Spring	I-III larval instar
<i>Tephrosia disputaria</i> Guen	+	Spring	II-III larval instar
Psychidae			
<i>Acanthopsyche moorei</i> Heyl	+++	Summer	All larval instar
Lasiocampidae			
<i>Suana concolor</i> Wlk	++	Spring, winter	II-III larval instar
<i>Trabala vishny</i> Lef	++	Spring, winter	II-III larval instar
Limacodidae			
<i>Thosia cana</i> Wlk	++	All seasons	I-V instar larvae
<i>Parasa lepida</i> Cram	+	All seasons	I-V instar larvae
Pyralidae			
<i>Chilo auricula</i>	++	Spring, late summer	I-III instar larvae
<i>Pephoteryx</i> sp	++	Spring, late summer	Throughout larval stage
Arctidae			
<i>Amsacta moorei</i> Butler	+++	All seasons	I-Vth instar larvae
<i>Diacrisia obliqua</i> Walker	+++	All seasons	I-Vth instar larvae

+++ Major, ++ Occasional, + Minor

seasonwise relationship between meteorological parameters and the incidence of only the major pests of primary tasar food plants as ascertained by the graph-in box through computer is presented (Figs 1,2,3 and 4)

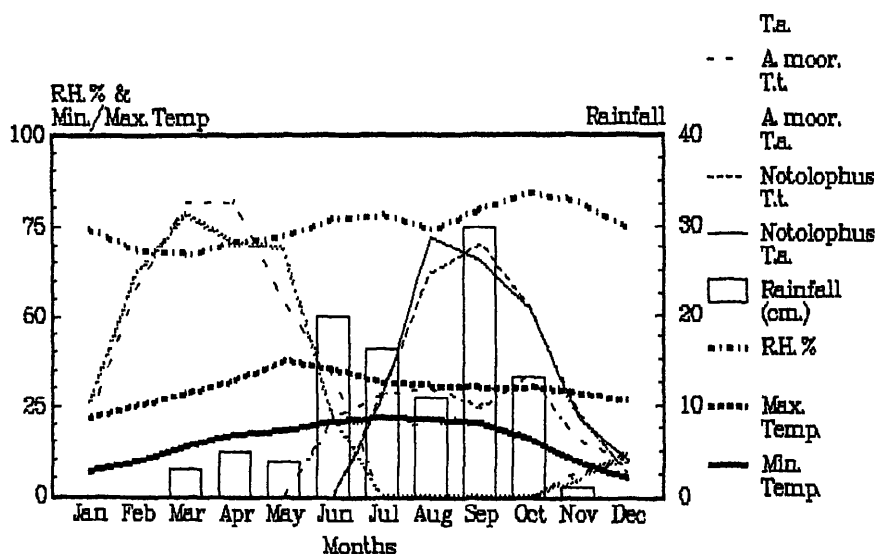


Fig. 4: Pest complex of primary food plants during 1993

Vapourer tussock moth, *Notolophus antiqua* Linn.

The larvae of *N. antiqua* has been found feeding on the leaves of *T. arjuna* and *T. tomentosa*. The incidence is localized in the initial stages but shortly the larvae spread to the other plants as well. High incidence was recorded in August (76 per cent in *T. arjuna*) and September (70.45 per cent in *T. tomentosa*) during 1992. During this period, mean minimum and maximum temperature varied from 21.22 to 24.54°C and 26.43 to 26.72°C respectively with average mean relative humidity being 84.97 to 86.83 per cent. The pest incidence declined sharply in the month of November-December. A critical observation of the abiotic factors and the incidence of insect pests recorded during 1992 and 1993 revealed that moderate temperature (26.0°C) under the influence of high humidity (80.15 per cent) followed by heavy rainfall provided conducive conditions for the build up of *N. antiqua* population. Singh *et al.* (1991) reported that *N. antiqua* was the dominant species having maximum population in the fields during this period. The population trend is similar in 1993 also, although there is variation in the percentage of infestation (72.34%) in *T. arjuna* and 69.69% in *T. tomentosa* during August and September, respectively. The data indicates that both the food plants are highly susceptible to the tussock moth and August-September is the most suitable period for population

build up Singh and Thangavelu (1993a) reported the cause of the population outbreak

Bihar Hairy Caterpillar, *Diacrisia obliqua* Walk.

The Bihar hairy caterpillar is a sporadic pest in tropical tasar region of India. Incidence starts from March-April and continues up to November. Population gradually increased and attained its peak during August-September and October. The highest percentage of population was 29.16 in *T. tomentosa* and 32.14 in *T. arjuna* during the month of August and October, 1992. Fairly high temperature (30.19°C) with intermittent rainfall and average humidity 70 ± 5 per cent, favoured the population build up of the pest in the second crop rearing season of tasar silkworm. The incidence was highest (44.44 per cent and 33.33 per cent) in *T. arjuna* and *T. tomentosa* respectively during October, 1993. Average minimum temperature and maximum temperature was 15.54°C and 30.10°C with an average relative humidity of 84.25. With the sudden decrease in the temperature and the intermittent rainfall the pest population declined.

Bag worm, *Acanthopsyche moorei* Heyl.

A. moorei is an important pest of *T. arjuna* and *T. tomentosa*. The caterpillars construct the bags from small pieces of the foliage by fastening the pieces together with silk. The leaves of *T. arjuna* and *T. tomentosa* were eaten by these bagworms. With the decreasing temperature and average relative humidity, this pest appeared at nursery stage and its population continued to build up throughout the sprouting stage of the food plants. During summer, 1992, with the temperature (32°C), a moderate relative humidity (62 per cent) and longer sunshine duration, the pest appeared on the plant. A peak of 8.35 insects per plant was obtained when the maximum temperature was above 32°C . The highest percentage of population was 72.72 in *T. arjuna* and 80% in *T. tomentosa* during May 1992. During 1993, the maximum population was 82.35 and 70.58% in *T. arjuna* and *T. tomentosa* respectively, when the average maximum temperature was 32.10°C with 62.83 per cent relative humidity.

The three lepidopterous defoliators, *N. antiqua*, *D. obliqua* and *A. moorei* are noticed throughout the year on tasar food plants. All of them prefer to feed on the leaves. *N. antiqua* and *D. obliqua* are predominant during rainy season. The population of *N. antiqua* increases from second week of July and declines in the latter half of November; the maximum build up of population was recorded during August-September. The climate in rainy season is rather normal 15.87°C - 27.65°C and the atmospheric humidity is very high (RH 84.97 to 86.83 per cent). Similar population trend is noticed in *D. obliqua* but the population steeply declines towards November and in fact during the winter

season (December-January and February), the population is very small and is mostly constituted by the pupal stage. Singh and Thangavelu (1992a) reported similar observations in succession of insect pests. The population trend of *A. moorei* is rather different from the other two species, being more prevalent during summer season (April-May) when the maximum temperature exceeds (37.50°C) and the minimum temperature is low (18°C), while the atmospheric humidity is high (RH 71-79%). In all these three species, the effect of maximum temperature on the population level has been very significant and the effect is the same in the consecutive year (Figs 3 and 4) (Singh and Thangavelu, 1993b).

The population of these insects can be minimized by mechanical and cultural practices. The larvae of Bihar hairy caterpillar and vapourer tussock moth undergo diapause in winter (December-February). During the winter period, when the rearing of tasar silkworm is suspended, the larvae and pupae are collected and burnt in the field. It is found to be the most convenient way to minimise the pest load. Further, some regular farming practices, viz., weeding, inter-cultivation, pruning and pollarding ensure further reduction in defoliating insect population. Similar cultural and mechanical practices have been adopted for bagworm. Generally, even after successful adoption of these cultural and mechanical practices, pest incidence was recorded very high. To combat this, dichlorovos (Nuvan), 0.1 per cent is sprayed on the infested plants. Three sprays of dichlorovos, 0.1 per cent, at an interval of 10 days minimise the pest population. Effectiveness of dichlorovos for the control of *N. antiqua* on *T. arjuna* and *T. tomentosa* has been reported by Singh and Thangavelu (1992b). Further, an attempt has been made to use light traps as one of the devices in integrated pest management in tasar culture. For this purpose, pest-o-flash, an illumination device is used in the rearing field to attract these pests. The adult moths are trapped in large numbers. This phenomenon of phototropism among insects is also utilized in pest control under integrated pest management programmes in several cropping systems (Thangavelu, 1982). Cultural and mechanical control devices have been applied to control these system/shoot borer pests (Thangavelu and Singh, 1991). Although the mechanical and cultural methods have been recommended to control the defoliating insects, but these are cumbersome and not followed by rearers. So, it was considered desirable to try an egg parasitoid, *Trichogramma chilonis* Ishii for the control of these pests. Parasitoids attack egg mass of many lepidopterous pests such as shoot borer (*L. pseudonectus*), tussock moth (*N. antiqua*), hairy caterpillar (*D. obliqua*) and white moths. The colony of this parasitoid is maintained in the laboratory. Rice grains moth, *Corcyra cephalonica* is used as laboratory host. 'Tricho card' is prepared and it is distributed all over the field. The *T. chilonis* was colonised @5000 wasps/ha. The card having five day old parasitized host eggs were stapled at 25 spots/ha from July to October at 10-15 days interval.

The recovery tests were carried out and 100 egg masses of *N. antiqua* were collected. Forty five per cent egg clusters were found parasitized by *Trichogramma* sp. and in each cluster parasitism varied from 65 to 80 per cent. The information may provide a basis for better understanding of the strategy to be adopted for reducing the defoliating insect damage. Instead of regular spray schedule, cultural, mechanical, chemical and biological control methods have been utilized in compatible manner to reduce pest population and maintain them at levels below those causing economic injury.

ACKNOWLEDGEMENT

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Study of the Wild Edible Fruits in Nagaland State, India

N.S. Jamir

INTRODUCTION

The state of Nagaland is situated in The North East Region of India. The state is mostly inhabited by fourteen major distinct aboriginal Naga Tribes which have a rich plant folklore. These Naga tribes prefer to live mostly on the hill tops and slopes of mountain areas forming their isolated villages, surrounded by dense natural forests and are hardly connected to the nearby towns and developed areas. Therefore, these tribes mostly depend on the natural resources from the forests for their livelihood including the wild edible fruits as their foods, medicine and so on. In fact, the wild edible fruits have been an important source of food for the local tribal people from time immemorial and even before the domestication or introduction of present horticulture fruit plants. Even today, these wild fruits are a very important part of the food of tribal people, particularly during scarcity of food and famine.

LOCATION AND AREA

The state of Nagaland lies between 25° 6' - 27° 4' N and 93° 20' - 95° 15' E and has an area of 16,527 Km². It is bordered on the North by Arunachal Pradesh, on the West and North-West by Assam, on the South by Manipur and on the East by Burma. The altitudes vary from 194 m to 3348 m, with the highest peak lying at Saramati in the Tuensang District on the Burma border.

The climate of Nagaland is warm and sub-tropical over foothills, moderate and sub-tropical montane type in the midslopes and lower ranges of the western flank, and cool and temperate in the high hills. The rainfall in the state is quite varied with an average annual rate 200-250 cm, occurring over seven months from May-October, received mostly from the South-West monsoon. Temperature in the hills vary from 5°-25°C and in the foothills from 12°-32°C. Frost occurs over large areas during winter, but snow fall is rather rare.

The state is perhaps one of the richest and most interesting floristic region in the country. This richness and diversity of flora is mainly due to large variations in rainfall, temperature and altitudes in the area. Therefore, the state has

an excellent scope to conduct various research works for the welfare of the local people including a study of the wild, edible fruit plants

RESEARCH WORK

A good amount of research work has been contributed in the last one or two decades, within and outside the country, on the edible wild fruits (Anonymous, 1948-1972, Brown, 1951-1954, Cameron, 1977, Chengh, 1965; Fernal, 1943; Hill, 1939, Kanjilal, 1934-1940, Kolesnikov, 1943; Parma, 1982, Povlov, 1942, Saunders, 1934, Singh, 1978). However, so far there has been no information except some published papers on medicinal plants and the ferns, flora of Nagaland (Rao and Jamir, 1982a, 1982b, Jamir 1990, Jamir, 1988) It is well known that more than 50% of the edible fruits come from the forests alone, and therefore, the state of Nagaland offers an immense scope and potentiality for the study of the wild, edible fruits

METHODS

In this paper, an attempt has been made to survey the wild fruits that are available in the state. The information regarding the wild edible fruits was collected from local people from various places in this region during conducted field trips

In the enumeration, all the species of the wild edible fruits (Botanical names) have been arranged alphabetically and family names after the local names (Changkı) have also been mentioned as shown in the Table-1

CONCLUSION

In this paper, altogether sixty one species of wild edible fruits have been reported. In addition to this, more species can be made available by a thorough survey and study of the area. It is, however, a pity to observe that the valuable plants are vanishing rapidly due to various factors such as 'jhum' or 'shifting' cultivation, forests fire, felling of timbers and other human activities. As a result, there is an ecological imbalance and at the same time, the wealth of wild plants including the wild edible fruit plants are depleting day by day.

The author, thereby, would like to stress upon the urgent need of conservation and to identification of all the wild edible fruit plants that are available in the forests. It is quite certain that some of these wild fruits might be rich sources with nutritive value. Definitely, this will help to uplift the economic conditions of the tribal people particularly those living in the rural areas.

Table-1*

o	Botanical Names	Families	Local Names	Edible Parts
1	2	3	4	5
	<i>Amomum dealbatum</i> Roxb	Zingiberaceae	Langpamoalajang	Seeds
	<i>Ardisia crispa</i> , (Thunb) D C	Myrsinaceae	Alomeset-jang	Fruits
	<i>Artocarpus chaplasha</i> Roxb	Moraceae	Tazu/Saliyang	Pulp and Seeds
	<i>A. lakoocha</i> Roxb	Moraceae	Tzuremjang	Pulpy fruits
	<i>Baccaurea sapida</i> Muill Arg	Euphorbiaceae	Tangtsusu	Fruits
	<i>Calamus leptospathiz</i> Griff	Palmae	Injang-Kerosu (Tasola)	Fruits
	<i>C. erectus</i> Roxb	Palmae	Kerosu (Tepetiba)	Fruits
	<i>Castanopsis indica</i> A DC	Fagaceae	Kozu-jang	Seeds
	<i>Cayratia pedata</i> (Lamk) Juss ex Gagnep	Vitaceae	Wild grape	Berry
	<i>Caryota urens</i> Linn	Palmae	Asang-jang	Seeds
	<i>Cordia dichotoma</i> Forest f	Boraginaceae	Moksujiang	Pulp
	<i>Dillenia indica</i> Linn	Dilleniaceae	Oojang	Fleshy Pulp
	<i>Diospyros kaki</i> Linn	Ebenaceae	Kopiayang	Pulp
	<i>Dacyna indica</i> (Mail) Decne	Rosaceae	Wild apple	Fruit

(Contd)

1	2	3	4	5
	<i>Elaeagnus conferta</i> Roxb	Elaeagnaceae	Jamulasu	Fruit
	<i>Elaeocarpus floribundus</i> Bl	Elaeocarpaceae	Mojeblasu (White spotted)	Fruits
	<i>Embellica officinalis</i> Gaertn (Syn Phyllanthus emblica)	Euphorbiaceae	Lolasu/Lozu	Fruits
	<i>Eutada phatoloides</i> (Lo) Merr	Mimosaceae	Attong	Seeds
	<i>Ficus altissima</i> Bl	Moraceae	Akosujang/Rurujiang	Fruits
	<i>F. cyrtophylla</i> Wall	Moraceae	Rokrajang	Fruits
	<i>F. elastica</i> Roxb	Moraceae	Nisajang	Fruits
	<i>F. fulva</i> Reinw	Moraceae	Pangpangusu	Fruits
	<i>F. hirta</i> Vahl	Moraceae	Mamasu	Fruits
	<i>Ficus hispida</i> Linn	Moraceae	Memtsusu	Fruits
	<i>F. religiosa</i> Linn	Moraceae	Zorojiang	Fruits
	<i>Garcinia acuminata</i> Pl & Tr	Clusiaceae	Merilasu	Fruits
	<i>G. cowa</i> Roxb	Clusiaceae	Pela-mesong	Fruits
	<i>G. paniculata</i> Roxb	Clusiaceae	Mejeblasu	Fruits
	<i>G. tinctoria</i> Dunn	Clusiaceae	Sungsulasu	Fruits
	<i>Gironniera reticulata</i> Thw	Urticaceae	Patusujang	Pulp and seeds

(Contd)

1	2	3	4	5
	<i>Gnetum ghemon</i> Linn	Gnetaceae	Melemjang	Seeds
	<i>G. montanum</i> Mfg	Gnetaceae	Zakrojang	Seeds
	<i>Hodgsonia macrocarpa</i> (Bl.) Cogn	Cucurbitaceae	Asatong	Seeds
	<i>Juglans regia</i> Linn	Juglandaceae	Akawang	Seeds
	<i>Livistona jenkinsiana</i> Griff	Palmae	Surajang	Pulp and seeds
	<i>Magifera andamelensis</i>	Anacardiaceae	Chechetsu	Pulpy fruits
	<i>M. sylvatica</i> Roxb	Anacardiaceae	Pongensu	Pulpy fruits
	<i>Melia azedarach</i> Linn	Meliaceae	Aikjang	Fruits
	<i>Myrica exulenta</i> Ham	Myricaceae	Ajensu tasala	Fruits
	(Syn M. nagi, non Thunb.)			
	<i>Nelumbo nucifera</i> Gaertn	Nymphaeaceae	Lotus narajang	Seeds
	<i>Nephetum longana</i> Camb	Anacardiaceae	Remtsungluju	Fruits
	<i>Osbeckia nepalensis</i> Hook	Melastomaceae	Imlaksiasu	Seeds
	<i>Phoenix sylvestris</i> Roxb	Arecaceae	Remtsung kowitasola	Seeds
	<i>Physalis minima</i> Linn	Solanaceae	Poksakjang	Berry fruits
	<i>Prunus cerasoides</i> D Don	Rosaceae	Entsungjang	Fleshy Drupes
	(Syn P. puddum (Wall.) Roxb ex Brandis)			
	<i>Prunus nepalensis</i> Steud	Rosaceae	Mesusingjang	Fleshy Drupes

(Contd.)

2		3	4	5
7	<i>Pyrus pashua</i> Buch Ham ex D Don	Rosaceae	Remtsung-plum	Fruits
8	<i>Rhus semialata</i> Murray	Anacardiaceae	Tangma/tangmo	Seeds
9	<i>Roydia suaveolens</i> , Roxb	Capparidaceae	Al-metsulasjang	Pulpy fruits
0	<i>Rubus ellipticus</i> Sm	Rosaceae	Japensu	Berry fruits
1	<i>R. lasiocarpus</i> Sm	Rosaceae	Janpensu-tanakla	Berry fruits
2	<i>Sapum baccatum</i> Roxb	Euphorbiaceae	Metongjang	Fruits
3	<i>Saurauia napaulensis</i> Dc	Saurauaceae	Asutenla	Ripe berries
4	<i>Spondias pinnata</i> , (Linn f) Kurz (Syn <i>S. mangifera</i> Willd)	Anacardiaceae	Kaosujang	Pulpy fruits
5	<i>Syzygium cumini</i> (Linn) Skeels (Syn <i>Eugenia jambolana</i> Lamk)	Myrtaceae	Longinjang	Fruits
5	<i>Sterculia urens</i> Roxb	Sterculiaceae	Mongrongjang	Seeds
7	<i>Terminalia bellirica</i> Roxb	Combretaceae	Liangjang	Fruits
3	<i>T. chu hula</i> Retz	Combretaceae	Lingakjang	Fruits
0	<i>Vitis lanceolaria</i> Laws	Vitaceae	Remtsung-grape	Berries
0	<i>Zalacca secunda</i> Griff	Palmae	Oktjang	Seeds
0	<i>Zizyphus mauritiana</i> Lamk (<i>Z. jujaba</i> (L.) Gaertn)	Rhamnaceae	Pokerajang	Fruits

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Section 7

MARKETING OF NTFP

Marketing of Non-timber Forest Products in Kerala — An Overview

Anjana Shanker and P.K. Muraleedharan

INTRODUCTION

Effective marketing strategies play a significant role in fetching better remuneration to the rural poor who are dependent on the collection of Non-timber Forest Products (NTFPs) In Kerala, NTFP markets are highly imperfect, and traders still dominate in determining the terms and conditions of purchase and sales of the products Although, the Government has the monopoly to procure and market NTFPs, a major part of it is marketed by the private traders So far, not much attention has been paid to study the various aspects of marketing of NTFPs in Kerala As a result, information regarding the different aspects of marketing of NTFPs in the State is limited

Collection of NTFPs is a supplementary source of income to a majority of the tribal population in Kerala Even today, there exist a few tribal settlements, in interior forests, where NTFP collection is the only source of income About hundred NTFPs that may be exploited from the forests on a commercial basis have been notified by the Forest Department Of these, only twenty to twenty five items are being collected regularly Bamboos (*Bambusa bambos*, *Dendrocalamus strictus*), reeds (*Ochlandra* spp.), canes (*Calamus* spp.), cheevakkai (fruit of *Acacia concinna*), kunthirikkam (resin from *Canarium strictum*), honey, pathripooovu (aril of *Myristica dactyloides*), nellikka (fruit of *Embilca officinalis*) are the important products in terms of quantity collected While bamboo from the forests have been earmarked, by the Forest Department, exclusively for the use of pulp and paper industry whereas reeds are assigned for the use of both the pulp and paper industry and traditional mat and basket weavers in Kerala Therefore, these products do not enter the market directly The Kerala State Federation of SC&ST Development Co-operatives Limited*, private traders and tribals (primary collectors) are identified as the three main marketing agents dealing with NTFPs in the State An attempt has been made here to give an overview of marketing of NTFPs in Kerala by analysing the

*For brevity, it is referred to as the Federation

working of the different marketing agents. The study is based on data gathered from the Federation, private traders and collectors.

MARKETING OF NTFPs — A HISTORICAL SKETCH

Before the advent of the Britishers, NTFPs were bartered by the tribals to the plainsmen. With the reservation of forests, the monopoly of collection and marketing of NTFPs was taken over by the Forest Department. Till late 1950's the Forest Department leased out the forest ranges to private traders to collect all NTFPs other than ivory, horns, honey and bee's wax which were collected by the Department. Later, forest ranges were auctioned to private contractors annually. These contractors employed both tribals and non-tribals for the collection. They paid nominal amounts to the gatherers as collection charge and sold the product at a higher margin. In order to prevent the exploitation of the tribals by these contractors, the State Government granted the right of collection of NTFPs to the tribes in 1978 (Government of Kerala, 1978). Tribal Service Co-operative Societies were started to facilitate this. For a period of three years, the entire NTFPs were purchased from these Societies by the Pharmaceutical Corporation of Kerala (Oushadhi). However, with the establishment of an apex body of the societies—the Federation in 1982, this form of marketing was discontinued. The Government entrusted the Federation with the monopoly right to procure and market all the NTFPs collected by the tribal societies (Government of Kerala, 1982).

MARKETING STRUCTURE

As mentioned earlier, the Federation, private traders and the collectors are the three major NTFPs marketing agents existing in Kerala. The four branches of the Federation, in Trivandrum, Adimali, Thrissur and Kalpetta districts, market the NTFPs of thirty four Tribal Co-operatives Societies, spread over the different districts in the State. The following figure shows the structure of NTFP market (Fig 1).

FEDERATION

Every year, the Minor Forest Products Committee*, allots the Forest Ranges to

*The Minor Forest Product Committee (MFPC), with the Chief Conservator of Forests as its Chairman, was constituted for deciding the forest range allotment, fixing lease rent, purchase price and selling price of the collected NTFPs. As per the instructions of the MFPC, the Societies are expected to pay 80% of the auction rate as collection charges, 5% as Commission charges to the Federation and the remaining 15% is for meeting their establishment cost.

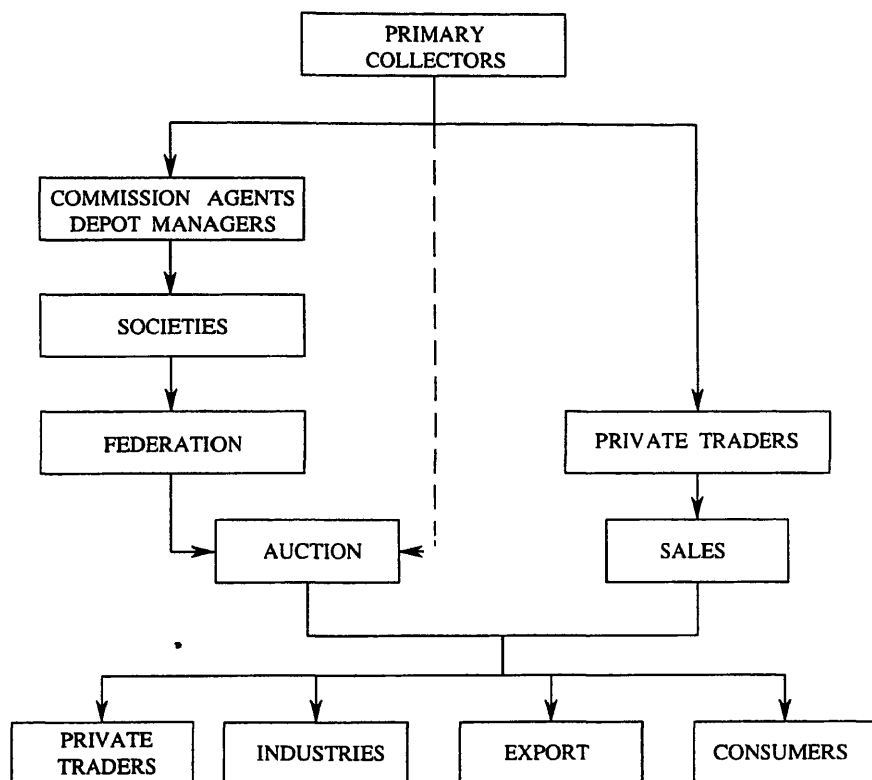


Fig. 1: Marketing structure of NTFPs in Kerala

different Tribal Societies To facilitate collection, the Societies establish collection depots inside the forests during the peak collection season, i.e., December to May. These depots are managed mostly by commission agents/depot managers who are mainly tribals. Commission agents are paid a fixed rate as commission while the depot managers are paid wages.

Most of the Societies depend on the Federation for meeting their financial requirements. Each Society is given an interest free advance which is distributed to the commission agents to pay collection charges to the tribals. When adequate quantity is collected from the different depots, auction notices are sent by the Federation to all the parties who have registered their name for attending the auction. At the auction, an upset price is fixed arbitrarily. If the auction is cancelled due to low rates or ring formation, the traders are given another opportunity to purchase the products. In this case, they are required to give in

writing the actual price they are willing to pay as in the case of quotations, before a stipulated time. If this rate is also very low, the auction is cancelled.

Sometimes the Federation invites quotations for those items which do not fetch good price in the auction. Quotation notices are sent to all interested parties and the highest bidder is selected on the specified day.

Another marketing practice adopted by the Federation is Negotiation. This is resorted to in the case of Medicinal plants like kurumthotti (*Sida rhombifolia*), orla (*Desmodium gangeticum*), moovila (*Pseudarthria viscida*), and karimkurinji (*Nilgurianthus ciliatus*) for Ayurvedic medicine manufacturing units. As these plants are needed in the raw form they cannot be stored till the auction procedure is completed. Therefore, the Federation enters into an agreement with the parties interested in purchasing these items and supply the same at the rate mutually agreeable.

The following graph (Fig. 2) illustrates the turnover of the Federation from 1982-93.

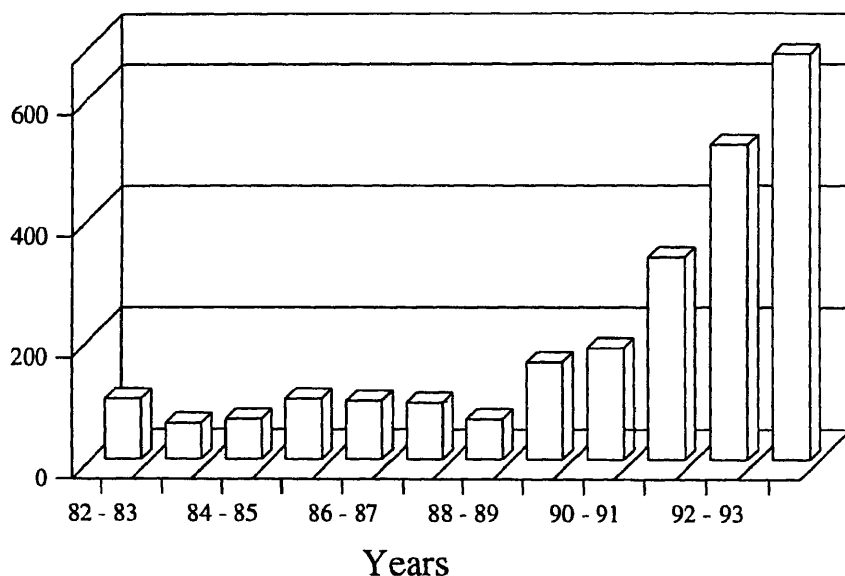


Fig. 2: Turnover of the Federation from 1982-83 to 1993-94 (1982-83 = 100)

The turnover of the Federation is more or less stagnant from 1982-83 to 1990-91. The main reason is that, even though the Federation has the monopoly to market NTFPs, the actual marketing was done by the Societies. These Societies used to market the same by inviting quotations. The collection charge paid

to tribals was significantly lower than that prescribed by the MFP Committee and the tribals began to sell the products to outside agencies resulting in the low turnover. Therefore, the Federation was forced to change this practice and it took over the responsibility of marketing of all products since 1991-92. This is reflected in the higher turnover from 1991-92 and can be attributed to the higher prices fetched at the public auction conducted by the Federation.

The details of quantity of major NTFPs traded and value realised by the Federation during 1993-94 are presented in Table-1.

Table-1: Major NTFPs Marketed by the Federation

Items	Total quantity (Kg)	Value (Rs)	% to total value
<i>Acacia concinna</i>	4,01,703	86,53,213	43.27
Black dammar	1,65,323	45,00,735	22.50
Honey	42,554	21,20,207	10.60
<i>Myristica dactyloides</i>	16,901	9,97,387	4.99
<i>Sida rombifolia</i>	98,915	4,37,725	2.19
<i>Desmodium gangeticum</i>	29,712	3,11,085	1.56
<i>Nilgianthus ciliatus</i>	51,648	2,96,666	1.48
<i>Pseudarthria viscida</i>	24,707	2,95,174	1.48
<i>Emblica officinalis</i>	70,273	2,48,876	1.24
<i>Sida rombifolia</i> (dried)	21,517	2,15,170	1.08
<i>Coscinium fenestratum</i>	22,193	1,27,607	0.64
Others	-----	17,96,155	8.97
Total	-----	200,00,000	100.00

Source: Compiled from Federation Records

Cheevakkai, black dammar and honey are the major products collected and traded by the Federation, in terms of value and quantity, accounting for 43%, 22% and 11% respectively. The main markets for cheevakkai and black dammar is in Tamil Nadu. Honey is sold at a fixed price and is not auctioned.

MARKETING OF NTFPs BY THE FEDERATION — SOME PROBLEMS

A number of problems are faced by the Federation in the marketing of NTFPs. Inadequate storage facility and lack of funds during the peak collection season are the two major hurdles that impede the smooth functioning of the Societies and the Federation. During the auction, when the buyers collude with each other, the Federation is forced to sell the items at low rates if the item kept for auction is a perishable one. Otherwise they will be forced to cancel the same. This will result in the funds being locked up in stocked items and accentuate the problem of inadequate funds.

Even though the aim of the Federation is to market both NTFPs and agricultural products of the tribes, it concentrates mostly in the marketing of NTFPs alone. Due to this, the tribals are forced to sell their marketable surplus and processed goods like mats, baskets, etc., to private traders. Along with this, they also sell NTFPs.

PRIVATE TRADERS

In spite of the efforts of the Federation and the Forest Department, nearly 60-70% of the NTFPs is marketed by private traders. Most of these private traders happen to be the former contractors and sub-contractors who took part in the auctions of ranges for MFP collection. These traders still manage to exert considerable control over the collectors. Their method of dealing with the tribes is entirely different from that of the Federation. The contractors provide the tribals with the necessary provisions, clothes, etc. They also extend financial assistance to the tribals when they approach them for the same—the most important factor from the collectors point of view. In turn the tribals sell the collected NTFPs to them to repay the loan. Thus a vicious circle is formed and maintained.

The private traders offer higher prices, than that offered by the Societies, but the collectors are cheated as the products are under-weighed. This situation exists only where the private traders have to compete with the societies. In remote areas where Tribal Societies do not function, the prices paid by the private traders are very low. The products are then transported to wholesale dealers or exported to other states. Some of these traders work as the agents of manufacturing units also.

The Federation often faces stiff competition from the private traders in procuring and marketing of NTFPs in Kerala. The private traders compete with the Federation by offering higher prices to the collectors as is shown in Table-2. This results in flow of products to the private sector and weakens the position of the Federation as a marketing agent.

Table-2: Collection Charges Offered by the Federation and the Private Traders (Rs /Kg)

Items	Federation	Private traders
<i>Acacia concinna</i>	8 00	12 00
Black dammar	18 00	20 00
Honey	30 00	45 00
<i>Embluca officinalis</i>	1 50	3 00
<i>Myristica dactyloides</i>	45 00	50 00
<i>Pseudarthria viscida</i> (dried)	8 00	6 00
<i>Desmodium gangeticum</i> (dried)	7 00	6 00
<i>Sida rhombifolia</i> (raw)	1 20	3 00
<i>Acacia tortia</i>	4 00	7 00

DIRECT AUCTION BY THE COLLECTORS

Besides the Federation and the private traders, the primary collectors directly auction their NTFPs. This practice is found to exist at *Kottur*, situated in the Agastyavanam Biological Park Range. This is locally known as 'Kaani chantha' (Kaani market). The local tribals come together every Wednesday and Saturday to market their agricultural produce and NTFPs. These items are auctioned off under the supervision of the Forest Department officials. Agricultural products and NTFPs worth approximately Rs 8000/- are sold in a week. The auction procedure is a highly informal one when compared to that of the Federation. This is a unique marketing system in Kerala where the tribes meet together in one place to market their commodities.

The main agricultural products marketed here are banana and betelnuts. Occasionally goats and poultry are also traded. NTFPs which are auctioned here include nellikka, honey, black dammar, karakka (fruit of *Elaeocarpus serratus*), kadukka poovu (leaf gall of *Terminalia chebula*), and cane baskets. These products have a high demand in the nearby markets at Kattakada and Trivandrum. The collectors claim that they are able to fetch higher prices for their products here than that in the nearby markets or co-operative society.

The main drawback of this system is that the products are not weighed properly. Only a guesstimate is made by the auctioneer. No official sanction or recognition has been accorded to this form of marketing by the Forest Department even though it has been in existence for the past 15 years or so.

CONCLUSION

In spite of all the efforts by the Federation and the Forest Department, the present marketing system of NTFPs in Kerala is still unorganised and often controlled by private traders.

Better marketing strategies, giving emphasis to safeguarding the interests of the collectors and the consumers should be formulated. At the same time, it should be ensured by the concerned authorities that NTFPs are being extracted on a sustainable basis.

Starting of provision stores along with the collection depots will enable the societies to wean away the collectors from the clutches of the private traders to a certain extent. Tie-ups with the end user—industries—can go a long way in eliminating the middlemen and the delay experienced in marketing certain products. This will also reduce the storage problems and consequent loss in value due to deterioration of stock.

*Kaani — Name of the tribal community residing in the forests of Southern Kerala

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Collection and Marketing of NTFPs by Kani Tribals of Peppara Wildlife Sanctuary, Kerala

G. Christopher and E.A. Jayson

INTRODUCTION

The Peppara Wildlife Sanctuary is situated in the South-West end of the Western Ghats in Thiruvananthapuram District, Kerala State. It lies in between 8° 7' and 8° 53' N latitude and 76° 40' and 77° 17' E longitude covering an area of 53 km². It is bordered on the North-East by Mundanthurai Tiger Reserve of Tamil Nadu, North side by Palode Reserve Forest, South by Nayyar Wildlife Sanctuary and South-West by Agasthyavanam Biological Park. The sanctuary is a conglomeration of undulating plains with varying vegetation types ranging from montane sub-tropical to tropical evergreen forests. Though it has remarkable diversity in vegetation types, Southern tropical moist deciduous forests cover the major area. It has also a rich variety of endemic and rare fauna. The maximum elevation of the sanctuary is 1717 m above msl (Chemmunji mottai). The mean temperature varies from 16°C to 35°C and the average annual rainfall is about 3200 mm.

TRIBALS

There are twenty-five tribal communities living in the forests of Kerala State. The Kani tribes of Thiruvananthapuram and Kollam districts contribute to the major part of the total tribal population living in the forests of Kerala (FIB, 1994). Like the other aboriginal hunting and gathering tribes, Kanikars also have the primitive history of hunting, gathering and shifting cultivation. Long back, the Kanikars were employed by the British Government to collect honey, wax, ginger, cardamom, damer and elephant tusks (Thurston, 1909). Many Anthropologists have admired their adventurous honey collection from the highly rugged rock cliffs and tree tops, which can be seen even today. Even though, the epidemically spreading modern civilisation have polluted the tribal culture, some Kani settlements still preserve their age-old traditions.

There are thirteen Kani tribal settlements inside the Peppara Wildlife Sanctuary. They are scattered in the buffer zone as well as in the core area of the sanctuary. Their main source of income is from agriculture supplemented by the gathering of NTFPs from the surrounding forests.

METHODOLOGY

The data were gathered during January, 1993 to June, 1994 from the Kottoor tribal market. Tribals, forest staff and local vendors were consulted and interviewed to gather information. Direct observations were made twice a month during the time of auction. Field visits were also conducted to record the extraction methods.

RESULTS

Kottoor Tribal Market

Kottoor tribal market is situated 8 km South of Peppara. History reveals that the tribals used to bring the NTFP and exchanged it with the non-tribals for salt, tobacco or clothes. The local vendors and villagers participated in this early method of exchange market. Later, due to some conflict between the vendors and tribals, the market was closed for a period. It started functioning again in 1983, with the initiation of the Forest Department, adopting a new system of 'open-auction'. In this method, the interaction of non-tribals and intermediators with tribals is very low. All the NTFPs and agricultural produces were brought to the market exclusively by the Kani tribals. Only the vendors locally called as 'Kachodakkar' came from outside. Occasionally, few nearby villagers also attended the market for particular items such as 'lamy' (Filter pan made of cane) or pure honey, when these items were not available in other markets.

The market functioned twice a week, on Wednesday and Saturday. It is arranged near the Kottoor forest station and two forest staff supervised the market transactions. The person who called the auction himself was a tribal. Due to the presence of the forest staff, disputes and exploitation of tribals were controlled. Tribals brought their products to this market even from a distance of 5 to 15 km. Both men and women took part in this process and male to female ratio was 1.3 : 1.1. Auction is on the basis of first cum first served and the amount is disbursed immediately. This type of open-auction system of sale enable the producer-seller to get fair prices for his produce eliminating mal-practices (Mishra, 1994). Total amount obtained by the tribals in a month from the market varied between Rs 9,098/- to Rs 22,777/-. This included the income from the agricultural products.

Fifteen items auctioned in the Kottoor tribal market are given in Table-1. Of these NTFP items, eight are common in the auction. Seven items namely, flowers of *Bryophyllum*, wild ginger, 'Manja valli', fruits of *Elaeocarpus glandulosum*, Gamboge, wild turmeric and 'Cuva leaves' were brought only rarely, in small quantities. This is due to the limited and seasonal availability of these products. The local indigenous medical practitioners also collected these items directly from the settlements. There are two varieties of cane and reed baskets

Table-1: NTFP items marketed in the Kottoor Tribal Market

Sl No	Local name	Common name	Botanical name	Part used
1	Chural kutta* Chural kooda* Lami*	Cane basket " Cane filter pan	<i>Calamus</i> spp " "	Stem " "
2	Eera kutta* Eera kooda*	Reed basket "	<i>Ochlandra</i> sp "	" "
3,	Kadukka*	Myrobalan	<i>Terminalia chebula</i>	Fruits
4	Kadukka poovu*	Leaf galls	<i>Terminalia</i> sp	Leaf
5	Panam poovu*		<i>Myristica dactyloides</i>	Aril of fruits
6	Thakali poovu	Bryophyllum flower	<i>Kalanchoe lasiocoma</i>	Flower
7	Thooku thenu* Cheru thenu*	Honey "	—	—
8	Kunthirikam*	Black Damer	<i>Canarium strictum</i>	Bark resin
9	Nellika*	Gooseberry	<i>Embilica officinalis</i>	Fruits
10	Chittaratha (Kolinji)	Wild ginger	<i>Alpinia galanga</i>	Rhizome
11	Manja valli	—	<i>Coccinia grandis</i>	—
12	Karakka	—	<i>Elaeocarpus glandulosum</i>	Fruits
13	Cuva ela	Cuva leaf	<i>Schumannianthus virgatus</i>	Leaf
14	Kodampuli	Gamboge	<i>Garcinia cambogia</i>	Fruits
15	Kasthoori manjal	Wild turmeric	<i>Curcuma aromatica</i>	Rhizome

*Major items

which are known by different names. In the case of honey, two varieties were collected and the cost also differed. The 'Cheruthenu' costed around Rs 100 for 750 ml whereas the common variety costed only Rs 50. The 'Cheruthenu' has high medicinal value and there was always a high offer and competition for it in the market.

Cuva leaves were collected by tribal women and children. Most of the leaves collected were sold directly to the nearby hotels. These leaves were brought in bundles and a bundle weighed about 20 to 30 kg. Each large bundle contained 15 to 20 smaller ones and each small bundle included 80 to 120 leaves. These smaller bunches weighed around 1 kg. Thus, an average 20 to 30 kg headload

of cuva leaves were sold at a rate between Rs 25 to Rs. 30. Due to the demand of the local tea shops and hotels, the amount of cuva leaves brought to the market was less.

Cane products were the main items marketed during the study period (Table-2). Due to the seasonal availability of gal nuts, the percentage (16.8%) of this item showed an increase. Declination of reed products (6.03%) may be due to the high availability of cane and gal nuts. The raw cane and reeds were not usually brought to the market. Tribals themselves collected it and did the crafting work to convert it into baskets. A cane basket fetches Rs. 20 to 40 and for a reed basket it varied between Rs 4 to 10. But the labour involved in making both of these items is the same.

Table-2: Major Non-Timber Forest Products auctioned in the Kottoor market and its value (December, 1993 to May, 1994)

Sl No	Products	Auction value in Rs	Percentage of total value
1	Cane products	21,065 00	34 00
2	Myrobalan	10,321 00	17 00
3	Ponnam poovu	6,877 00	11 00
4	Gooseberry	6,229 00	10 00
5	Black Damer	5,437 00	9 00
6	Honey	4,825 00	8 00
7	Reed products	3,705 00	6 00
8	Kadukka poovu	2,973 00	5 00

Tribal Co-operative Societies

The nearest tribal co-operative society is Gnaruneeli Tribal Service Co-operative Society Ltd. It has extension centres at Kallar, Kottoor and Amboori. All these centres are situated around the Sanctuary area. Out of which, only the Kallar centre received the products. All others were closed due to the non-availability of NTFPs because of their nearness to the Kottoor tribal markets. From the discussion with the tribals and the society staff, it was obvious that the tribals got fair prices from the auction market when compared with the society.

Agricultural Products

Agricultural products were also found in the market in equal quantities like the NTFPs. The major agricultural products were banana, betel nuts, pepper, pineapple, tapioca, lemon, jack fruit, chillies and yams. These crops were cultivated throughout the year and tribals received better remuneration for these items.

DISCUSSION

At present, the poor non-tribals living around the Sanctuary compete heavily with the tribals for the collection of NTFPs. Main competition is for the reed and cane. Though, the tribals practise little farming inside their settlements, it was not sufficient to meet their cash demands. The traditional gathering of NTFPs supported their cash needs. Due to management of the area as a Wildlife Sanctuary, the tribals could get sustained yields of NTFPs and because of the centralised auction market, they obtained better remuneration for their products.

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Marketing of Minor Forest Products in Himachal Pradesh—A Case Study of Dried Seeds of Wild Pomegranate

L.R. Sharma and S.C. Tewari

Forests meet innumerable requirements of the people of hills in the form of major and minor forest products. The contribution of forest revenue to the total state revenue has been estimated to be 8 per cent during 1987-88. Contribution of Minor Forest Products towards forest revenue accounts for 7.6 per cent in Himachal Pradesh.

Wild pomegranate (*Punica granatum*) fruit is one of the important Minor Forest Products produced in midhill regions of Himachal Pradesh. The tree is grown not only on the slopy natural grasslands but also in conjunction with agricultural crops. It gives higher fruit yield per tree when grown as an agroforestry combinate than as a sole crop on grass land and forests. The dried seeds of this fruit, called 'Anardana' has great medicinal value and also used for culinary purposes. Besides, the dried rind is used in dying and tanning industries. Anardana has been an important product in the market for long time and is commanding an attractive price.

Merely increasing production through plantation campaign will not improve the economic condition of producers, unless there is a well developed marketing system. Thus, efficient marketing is an integral part of production process of any enterprise. It means putting in efforts to realise the maximum price at the minimum cost. Efficient marketing system is all the more necessary in case of Anardana, which is prone to insect infestation, if stored for long. In the past, no study has been done so far to find out the marketing system of this produce. Therefore, in the present study, an attempt has been made to examine the existing marketing system for Anardana. The specific objectives of the study are as under:

- i) to estimate the economics of conversion of green fruits into 'Anardana', and
- ii) to study the marketing channels involved and producer's share in consumer's rupee in the marketing of 'Anardana'.

METHODOLOGY

Midhill zone (800-1600 m) of Himachal Pradesh provide a 'niche' for the cultivation of wild pomegranate. Narag Panchayat village of Pachhad Tehsil of Sir-mour District of Himachal Pradesh was selected purposely for getting information on production and marketing aspects. In all, 25 per cent households of the selected village were contacted to gather relevant information on pre-estimated schedules. The market data with regard to Anardana was obtained from different market intermediaries at various levels for Delhi and Solan market. The ultimate sample is comprised of 75 producers, 7 wholesalers, 4 village traders, 2 itinerant merchants and 16 retailers. The study was conducted in the year 1990-91.

RESULTS AND DISCUSSION

In order to reveal the importance of Anardana as a forestry product, in the village farming system, income from Anardana was worked out as a percentage of total farm income, net cash income and farm forestry income. The study showed that on an average, income from pomegranate fruit accounts for 18.42 per cent of total farm income. It contributed 31.20 per cent and 55.75 per cent towards net cash income and farm forestry income respectively. Evidently, higher proportion of Anardana income in total farm and forestry income on the one hand, reflects its importance in the farming system while on the other hand, its significant proportion in the net cash income of an average farmer, proves that it is an important ready source of cash income to the farmers. Besides, this study also revealed that 7.20 per cent of total labour time involved in all farm activities is consumed by Anardana making process.

Processing

Processing means converting a commodity by some process into marketable form, so that commodity can ultimately be used by the final consumers. Transformation of green pomegranate fruits into Anardana requires drying process.

The fruits of wild pomegranate are hand picked in the month of August and September, when they are ripe and brownish red in colour. Seeds along with pulp are separated with the help of sharp knives from the rind. Thereafter, the wet seeds are sun dried for about 10-15 days on some wooden trays. It takes about 30 mandays to get one quintal of Anardana from one tonne of green fruits by indigenous method of its preparation.

The cost of preparation of Anardana has been estimated and summarised in Table-1. It is evident from the Table that, after the cost of raw material, the labour constitutes the important cost item in the process of conversion of green fruit into Anardana. The total cost of conversion of one quintal of green fruits

into dry seeds works out to Rs. 251. The recovery percentage of main and by-product turns out to 10 to 17 per cent respectively from the green fruit. The total returns and net return figures from one quintal of green fruits in the study area, at 1990-91 prices, has been estimated at Rs. 412.75 and Rs. 161.75 respectively.

Table-1: Economics of Anardana Production in Narag Panchayat Village
(Per quintal of green pomegranate fruit)

Items	Quantity (kg)	Value (Rs)
(i) Cost of raw material	100	175.00
(ii) Labour cost (includes picking, separation of seeds and drying of seed)	manday	75.00
(iii) Depreciation on tools and implements	—	1.00
(iv) Total cost	—	251.00
(v) Recovery percentage of		
(a) Main product	10	400.00
(b) By-product	17	12.75
(vi) Returns @ Rs. 40 per kg for the main product and Rs. 0.75 per kg for the by-product	—	412.75
(vii) Net returns	—	161.75

Marketing Channels

The consumers of Anardana are generally located far away from the producing areas and it leads to the absence of direct contact with the producers. This gap is filled up by various intermediaries. Due to existence of various agencies working between producer and consumer, there are different marketing channels for the same commodity. The marketing channel means the passage through which a commodity travels from producer to the final consumer. The agencies involved in the marketing of Anardana and its by-product in study area are wholesalers, village traders, itinerant merchants, and retailers. The product is moved from the farm to the consumers through the following channels:

- i) Producer — Village Trader — Secondary Wholesaler — Retailer — Consumer,
- ii) Producer — Secondary Wholesaler — Retailer — Consumer,
- iii) Producer — Primary Wholesaler — Secondary Wholesaler — Retailer — Consumer,
- iv) Producer — Retailer — Consumer,
- v) Producer — Itinerant Merchants — Secondary Wholesaler — Retailer — Consumer, and
- vi) Producer — Consumer

Sale through Primary Wholesalers Twenty one growers out of 75 marketed their produce through primary wholesalers sitting in the village itself. Marginal and small farmers who have little marketable surplus sell their product through

this system. About 25 per cent of the total produce was estimated to be sold through this agency in the village.

Sale through Village Traders This agency is most commonly used in the channel 1). The village traders generally purchase the produce from the farmers on the prevalent prices in the village. Twenty eight farmers disposed of about 33 per cent of the total produce, produced in their area through this intermediary. Marginal and small farmers are the main suppliers to the village traders in the study area.

Sale through Secondary Wholesalers This functionary is generally followed by big farmers who have large marketable surpluses for sale. The product is sold in the terminal markets. In 13 per cent of the total samples taken, farmers sold nearly 27 per cent of their total produce through this agency.

Sale through Itinerant Merchants Itinerant merchants collect the produce from the doorsteps of the growers and sell it in the distributional centers. About 13 per cent of the growers are reported to have sold their produce to the itinerant merchants. About 8 per cent of the total marketable produce was sold through this agency.

Sale through Retailers Four farmers adopted this agency for the sale of Anardana. The total quantity marketed through this channel worked out to 6 per cent of the total Anardana sold.

Direct Sale to Consumer This channel establishes a direct relationship with the consumer. It promises a higher share to producer in consumer rupee. Two growers sold 114 kg of Anardana directly to consumers.

Time of Sale

Anardana is a perishable commodity and cannot be stored for long at the farm households. In the study-village, the commodity is ready for sale in the month of October. Its sale prolongs up to the month of December. In the retail markets, its sale is more during the summer months than in winter.

Grading

So far there are no standards and grades of Anardana prescribed by any agency. However, the producers of the study area have been grading their produce on the basis of the colour, i.e., red, white and black. The red coloured Anardana is considered to be of superior grade than the other two grades. The quality of Anardana is directly affected by the time of picking and method of preparation. The present study revealed that fruits picked in the month of September produce 'A' quality Anardana.

Packing

Packing of Anardana is equally important in its marketing process. Packing is

generally done in the gunny bags by the producers. In the distributional centres, repacking is done by the wholesalers. At the retail points, especially in tourist spots, it is usually packed in polythene bags of 200 gm, 250 gm, 500 gm and one kilogram capacities

Transportation

The provision of speedy and efficient transport is vital for effecting the sales in the distant markets. Head loading is the most common practice to carry the produce to the roadhead. The mode of transportation depends on the distance to be covered and the quantum of the produce. Other things being equal, longer the distance, more efficient has to be the mode employed for transportation. Also, more the production, longer the distance it will cover to reach the consumer. Trucks are the important means of carrying the produce to the Delhi and other plain markets. For solan market (local market) the producers reported buses as the major means of transportation followed by trucks. The transportation cost per quintal of Anardana from village to roadhead is estimated at Rs. 2. Cost incurred by the farmers in transporting it from roadhead to Solan and Delhi is Rs. 8 and Rs. 22 respectively.

Price Spread

Price spread refers to the difference between the price paid by the ultimate consumer and price received by the producer. Price spread includes the costs and margins of different agencies. The marketing costs comprise the costs of assembling, transportation, storage, grading and handling, etc. The margins include the returns to the intermediaries for the performance of their functions. The study of price spread assumes importance when the aim is to protect the interests of producers and consumers. These objectives can be ensured only if the services of intermediaries are made available at reasonable costs. Such studies would indicate the items and area where scope for economisation might exist. Down below, costs and margins for Anardana have been discussed. Delhi and Solan markets were studied in detail for working out producer's share in consumer's rupee.

Delhi Market: Delhi happens to be the main market of Anardana. More than 75 per cent of the produce was marketed through channel (i), (ii), and (iii) to Delhi market, therefore producer's share in consumer's rupee was calculated for these channels only. Producer's share in consumer's rupee was found to be highest (55.78 per cent) when growers channelised their produce through channel (ii) in Delhi market. The share of producers in consumer's rupee in channel (iii) and (i) was 36.16 per cent and 33.63 per cent respectively (Table-2). The highest share of producer in channel (ii) was due to direct sale in the terminal

market involving less number of intermediaries. This supports the belief that larger the number of intermediaries involved, lower the share in consumer's rupee

Table-2: Price Spread, Marketing Costs, Margins for Channel i), ii) and iii) in Delhi Market

Particulars	Estimated Charges in Rupees/quintal		
	Channel (i)	Channel (ii)	Channel (iii)
1 Producers sale price	3300 00 (44 00)	5000 00 (66 66)	3500 00 (46 66)
2 Expenses paid by producers	777 50 (10 37)	816 00 (10 88)	788 00 (10 50)
3 Net price received by producers	2522 50 (33 63)	4184 00 (55 78)	2712 00 (36 16)
4 Price received by primary wholesaler/ village traders	5000 00 (66 66)	—	5000 00 (66 66)
5 Expenses paid by primary wholesalers/ village traders	265 50 (3 54)	—	239 00 (3 19)
6 Net margin of primary wholesaler/village traders	1434 50 (19 12)	—	1261 00 (16 81)
7 Price received by secondary wholesaler	6000 00 (80 00)	6000 00 (80 00)	6000 00 (80 00)
8 Expenses paid by secondary wholesaler	125 00 (1 66)	125 00 (1 66)	125 00 (1 66)
9 Net margin of secondary wholesaler	875 00 (11 66)	875 00 (11 66)	875 00 (11 66)
10 Retailer's price	7500 00 (100 00)	7500 00 (100 00)	7500 00 (100 00)
11 Marketing costs borne by retailer	414 00 (5 52)	414 00 (5 52)	414 00 (5 52)
12 Net share realised by retailer	1086 00 (14 48)	1086 00 (14 48)	1086 00 (14 48)
13 Consumer's price	7500 00	7500 00	7500 00

Figures in parentheses indicate the percentage of consumer price

The margin of village trader was found highest (19.12 per cent of consumer's price) followed by primary wholesaler (16.81 per cent). The profit margin of retailer works out to 14.48 per cent in all the channels. The net margin of secondary wholesalers was Rs. 875 in one quintal worth of Anardana.

Producer's marketing costs ranged between 10.37 per cent to 10.88 per cent of the consumer's price. Marketing costs borne by retailers was 5.52 per cent while that of primary wholesaler/village trader was around 3.50 per cent. The expenses incurred by secondary wholesalers was the least (1.66 per cent of consumer rupee) among all the intermediaries involved in the trade. The producers generally prefer private traders because private agencies provide financial help as and when needed.

Solan Market: Solan market is emerging as a developing town in the vicinity of the studied village. Some part of the Anardana production is sold in the town itself. Channel (ii), (iv) and (v) is generally followed in this town. The break-up of price-spread in respect of Anardana at Solan market is presented in Table-3. In channel (ii) where two intermediaries, viz., secondary wholesaler and retailer function in the market, brings the producer's share in consumer

Table-3: Price Spread, Marketing Costs, Margins for Channel (ii) and (iv) in Solan Market

Particulars		Estimated Charges in Rupees/quintal		
		Channel(ii)	Channel (iv)	
			Case I	Case II
1	Producers sale price	3850 (77 00)	4000 (80 00)	4000 (61 53)
2	Expenses paid by producers	806 (16 12)	806 (16 12)	806 (12 40)
3	Net price received by producers	3044 (60 88)	3194 (63 88)	3194 (49 13)
4	Price received by secondary wholesaler	4300 (86 00)	—	—
5	Expenses paid by secondary wholesaler	122 (2 44)	—	—
6	Net margin of secondary	328 (6 56)	—	—
7	Retailer's price	5000 (100 00)	5000 (100 00)	6500 (100 00)
8	Marketing cost borne by retailer	210 (4 20)	210 (4 20)	250 (3 85)
9	Net share realised by retailer	490 (9 80)	790 (15 80)	2250 (34 61)
10	Consumer's price	5000 (100 00)	5000 (100 00)	6500 (100 00)

Figures in parentheses indicate the percentage of consumer price

rupee to the extent of 60.88 per cent. The secondary wholesaler's and retailer's margin works out to 6.56 and 9.80 per cent respectively in the Anardana trade. As far as marketing costs are concerned, maximum cost is borne by the producers (16.12 per cent) followed by retailers (4.20 per cent) and secondary wholesaler (2.44 per cent). In case of channel (iv), two cases were observed in the market. In first case, the ordinary retailers were contacted and market data obtained. The second forms a special case wherein the retailers have their shops in the tourist spots. The analysis of marketing margins and costs in channel (iv) reveals that the producer's share in consumer rupee was 63.88 per cent in first case and 49.13 in tourist spots (second case). The net share realised by retailers in tourist spots was as high as 34.61 per cent, while in ordinary retail shops, the

margin works out to 15.80 per cent only. This reflects the imperfections prevailing in the Anardana market in the Solan town. On an average, the retail prices charged from the tourists was 20 per cent higher than the prices prevailing in the ordinary markets.

CONCLUSION

The present study was taken up to study the economics of processing and marketing of Anardana, an important forest product, produced in mid-hill regions of Himachal Pradesh. The study finds that majority of producers generally prefer private traders to dispose off their produce because of credit marketing linkage facility. About 33 per cent of total produce was marketed through the channel, Producer — Village trader — Secondary wholesaler — Retailer — Consumer (Channel i). Twenty five per cent produce was disposed off through channel, Producer — Primary wholesaler — Secondary wholesaler — Retailer — Consumer (Channel iii) while 27 per cent produce was marketed through Producer — Secondary wholesaler — Retailer — Consumer (Channel ii). Delhi happens to be the major market for this product, though some part of the produce is consumed at Solan market itself. The share of producer in consumer's rupee was found higher, when the number of middlemen in the marketing system was lesser. Retailers maximised their share when sale was effected in tourist spots. It is suggested that for efficient marketing, co-operative institutions should be toned up in the region to co-exist with the regulated markets.

***Daphne* and Herbs Trade—A Case Study of a Nepali Hill District**

Shambhu Lama, Patrick Robinson and Chandra Rai

BACKGROUND

This paper is based on a micro study carried out in 1992 in Dolakha District, one of the districts in the middle hills of central Nepal. Collectors, contractors and businessmen were interviewed concerning the past and present trade of *Daphne* (used for Nepali paper production) and various herbs (15 species — particularly medicinal plants). The paper describes the trade mechanism and the sharing of benefits among different actors involved in the business. Estimates of quantities harvested and profits made at various levels in the trade are provided. The local population derives little profit from the trade, while large profits are made by middle men and exporters. Prices have risen fast in the last few years, because of depletion of the resources. Practical problems in obtaining reliable information have also been described.

Under the present system of harvesting, whereby contractors are given permits for specific quantities of harvested product, from national forests, there is no incentive for sustainable management of the resource. Further, the royalties paid to the Government are not significant. However, with the changed Government policies (1990), aiming to handover use right and management to Forest Users Group, the possibilities exist now for improvement of sustainable production of the products and for improved income to local people through a greater control on the trade. However to date, the implementation of the new forest Act (1993) has not been effective since the Forest Rules and Regulations have not been amended to follow on from the spirit of either the new policy or the Act.

All aspects pertaining to *Daphne* and herbs trade of Nepal and particularly of Dolakha District pointed out above are dealt below in detail along with discussion and recommendations.

INTRODUCTION

Daphne is a shrub (up to 3–4 m), the bark of which is used for the production of paper. The raw material is called '*lokta*'. Normally, the plant itself is also

called 'lokta'. *Daphne* is not traded in its crude form. It is processed to make paper, which is usually called 'hand made Nepali Paper'. *Daphne* is commonly found at altitudes ranging from 2300 m to 3000 m in high altitude forests (oak, fir, hemlock, etc.). Herbs are also concentrated in this range

Herbs refer to the medicinal and aromatic plants. Among herbs, medicinal plants, often called '*jaributi*' are more used than aromatic ones.

The trade in *jaributi* is age old and supports large number of collectors, porters and traders (Edward, 1993) and the history of paper making as a rural based cottage industry in Nepal can be traced back to at least the 12th century A D (Trier, 1972, quoted in Jeanrenaud, 1984), when locally made paper was used extensively for the publication of *mantras*, tracts and books of religious and secular nature (Bajracharya, 1983, quoted in Jeanrenaud, 1984)

Exports of some medicinal plants from Dolakha District to Japan are known to have taken place up to the 1940s. In this district, there are temperate, sub-alpine and alpine forest types. Herbs and *Daphne* are the most important traded Non-Timber Forest Products (NTFPs) of this area. However, Bamboos are very important in the local economy. *Alloo* (*Girardiana diversifolia*) is also used for fibre production for clothing/carpets and has potential for export.

The paper is based on the case study in Dolakha District. The study was carried out in 1992 by interviewing collectors, contractors and businessmen. The secondary data were also obtained from the District Forest Office and its Range Offices. Some data have been up-dated more recently. The district has a population of almost 230000. A large number of men and women have to migrate seasonally elsewhere in Nepal and abroad to supplement their household income for purchase of extra food and other basic goods. The altitude range of the district is 700 to 7000m. This paper concentrates on two plants, *Daphne* and *Churaito* (*Swertia* spp.) harvested from the district to illustrate the problems and potential of production and trade.

Limitation

The data available in District Forest Office regarding the total quantity of herbal plants harvested in the district are very limited and not existing in the form desired by this study. As to how much the official data reflect the reality is another issue that needs contemplation. Registering in the Forest Office means paying royalties. In order to avoid paying royalties, several ways exist for harvesting and exporting the goods illegally. The Police Checkpost and the Forest Offices do not have necessary machinery to see whether they match the official paper actually permitting the quantity for trade.

The discussion with the businessmen in Kathmandu provides little information about the trade mechanism beyond Kathmandu. People are very reluctant to

tell the truth, especially when it comes to the question of what is the actual rate and the margin of profits

TRADE OF LOKTA (*DAPHNE*)

Actors and Process

An entrepreneur (local contractor) gets the permission for opening a paper factory through the 'Cottage and Village Industries Office'. Each year, the contractor applies for permission from District Forest Office for collecting a certain amount of *Daphne*. Royalties have to be paid in advance. After that, the contractor asks the collectors to supply the necessary quantity of *Daphne* which is given to the paper makers at the factory. Once the paper is made, the contractor sells it to dealers in Kathmandu who retail it to the producers of final products such as envelopes, notebooks, etc. Final products are exported mainly to other countries.

There are mainly seven stages in this trade, from collector to exporter.

- | | |
|------------------------------------|-----------|
| 1 <i>Daphne</i> Collector | 1st stage |
| 2. Local Contractor (entrepreneur) | 2nd stage |
| 3 Paper Maker (skilled labourer) | 3rd stage |
| 4. Local Contractor | 4th stage |
| 5 Dealer (wholesaler in Kathmandu) | 5th stage |
| 6 The producer of final product | 6th stage |
| 7 Seller (exporter) | 7th stage |

Daphne harvesting generally begins in October and continues up to mid May, usually with two months break during mid December to mid February due to cold climate. The people who collect *Daphne* bark do not make paper. On the other hand, an entrepreneur and a paper maker do not harvest *Daphne* bark.

Total Harvest and Trade

As per official record, some 94 metric tonnes of *Daphne* were harvested for paper production in Dolakha District over the past 6 years from 1986 to 1991. Adding a rough estimate of half the quantity harvested without permission, the figure would be some 140 mt making an average of 23 mt harvested annually. Records of District Forest Office shows that the amount of paper traded from 1987 to 1991 was approximately 17,000 kori (34,00,000 sheets) or 3,400 kori per year. Details are given in Fig 1.

Relative Profits

One *dharni* (2.4 kgs) of *Daphne* raw material can produce 1 kori paper, i.e., 200 sheets of a size of approximate 50 x 70 cm. Trying to summarize the income

Table-1. Relative Profits (Nepali Rs) Gained by Various Actors per Year Out of 1 Dharni (2.4 Kg) of Daphne and Paper Produced from it (Based on 1992 Data)

Actor	Relative profit from 1 Dharni (2.4 kg) of Daphne in 1992			Total harvest of Daphne	Estimated total share of profits in Rs	Approximate No of people involved	Approximate share of Gross profit	Remarks
	Cumulative Price (Rs)	Share of profit (Rs)	% of total profit					
Collector	22	22	2.93	6500	143,000	400	357	
Local Contractor	25							This amount is spent as a royalty and sales tax, no profit
Government		3	0.4		19,500		19,500	Royalties, Sales Tax (Rate of 1991)
Paper maker	80	55	7.33	9 hrs of labour	357,500	40	8,937	
Local Contractor	250	170	22.67	Initial investment storing goods*	1,105,000	10	1,10,500	
Dealer Kathmandu	500	250	33.33	Initial investment storing goods	1,625,000	5	3,25,000	
Producer of Final Products	625	125	16.67	Factory in KTM Entrepreneurship	812,500	5	1,62,500	

(Contd)

Table-1 (Contd.)

Actor	Relative profit from 1 <i>Dharni</i> (2.4kg) of <i>Daphne</i> in 1992				Total harvest of <i>Daphne</i> Dharni 2	Estimated total share of profits in Rs	Approximate No of people involved ³	Approximate share of Gross profit	Remarks
	Cumulative Price (Rs.) ¹	Share of profit (Rs.)	% of total profit	Investment					
The Seller Exporter	750	125	16.67	Shop and contacts in KTM + Enterp		812,500	5	1,62,500	
Total	750	750	100						

Note

- 1 The calculation is based on the lowest price (Rs. 250 per *Kori-Dharni*) rate that local contractor gets per *kori* of paper in Kathmandu
- 2 The price ranges up to Rs. 450 per *kori* with associated increases in price through the exporter
- 3 6500 *Dharni* is the average of last 6 years officially harvested amount
- 4 There are 10 Nepali hand made paper factories in the district, each with about 40 collectors and about 4 paper makers on an average
- 5 Each paper factory deals directly with Kathmandu
- * Rs. 5 as cost of caustic soda, Transport to KTM

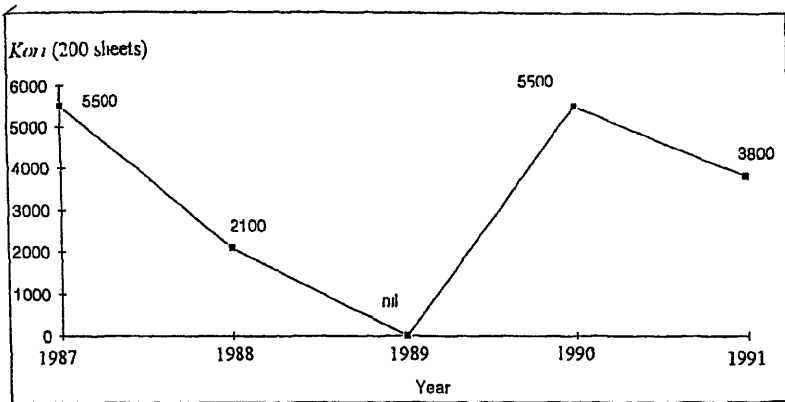


Fig. 1: Amount of Lokta paper traded to Kathmandu (kori/Year) (Official Record)

Source District Forest Office, Dolaka, 1992

received by various actors per *dharni* of *Daphne*, as shown in Table-1.

The comparison of gross income shows that the amount of money per unit of *Daphne* going to the government treasury is the lowest, while the amount going to the dealers in Kathmandu is the highest. The local contractor's share is just below that of the dealer in Kathmandu. The producer of the final product and the trader get an equal share slightly below that of the local contractor. After the government revenue, the local collector who is the primary actor in the process, gets the least share of the whole income. It has not been possible to assess the costs of the various actors (except for that of the collectors) to provide an estimate of net profit.

On an average, the daily wage rate of an unskilled labourer is Rs. 40. The paper makers and collectors are receiving around Rs. 60 per day which is equivalent to the daily wage rate of skilled labourer.

The official procedure prescribes a strong monitoring system aiming in theory at a sound 'check and balance' on the amount of *Daphne* permitted and actually harvested. The raw material collected has to be brought to a certain place where the official from the concerned Forest Office verifies the consignment and gives permission for transporting it to the factory. Prior permission is required for harvesting and subsequently for transporting the paper. Royalty is only paid on the amount harvested. However, in reality, the matching of the harvested and traded quantities is seldom done. The contractor (factory owner) has to send periodic reports to the concerned Forest Office regarding the amount of *Daphne* used and the amount of paper produced. As per the contractor's report, each *dharni* of *Daphne* produces 1.5 kori (300 sheets) of paper. But

actually paper makers reported that one *dharni* of *Daphne* can produce only 1 *kori* of paper. The idea is to record a higher amount of paper production per *dharni* of *Daphne* so that some quantity of *Daphne* can be taken for use straight from the forest to the paper making factory without paying the royalty and sales tax. This way the contractors can use 50% more *Daphne* than the quantity permitted.

Harvesting Practices of *Daphne*

The 'Rules and Regulations' of the District Forest Office concerning the harvesting technique make it necessary to cut *Daphne* at least 10 cm above the ground level and the bark should be peeled only from the cut stem. Plants having a size below 1 m in height and 3 cm in diameter should not be cut. The present harvesting practice, however, is that the stem is broken at a convenient height of about one meter and the bark is peeled from the top to the bottom of the broken stem right up to the roots. The main reason behind this practice is as follows: The District Forest Office makes an agreement with a contractor who is explained these terms and conditions of harvesting. But the actual collector in the forest often does not know about these rules, and even if he does, there is no incentive to follow the regulation, labour inputs being lower with the currently used technique. This practice damages the meristematic tissues and the root system often resulting in the death of the plant and this reduces the regeneration potential. There is no proper mechanism to ensure that the harvesting practices prescribed by the Forest Office are applied.

Hardly any concern has been shown regarding the management aspect by the government which merely bans harvesting occasionally or puts an upper limit on harvestable quantities. The existing forestry administration is not sufficiently equipped to implement its Rules and Regulations. On the other hand, the people who harvest *Daphne* have no incentive to manage it on sustainable basis, since up to now the *Daphne* is harvested from government forest. Dolakha District can be cited as an area where the source of *Daphne* is decreasing due to uncontrolled harvesting practices (Amatya 1984). Even if there is a lack of inventory data of this resource, it is clear according to various informations that due to the prevailing unorganized and destructive way of harvesting of considerable amounts of *Daphne* (16mt / year), the availability of the resource is endangered.

Prospects for International Trade

While the prospects for export of *Daphne* paper and its products are generally good, the increasing competition from paper handicrafts from other sources elsewhere in Asia, due to higher quality control and relatively cheaper prices, is currently limiting the demand for *Daphne* products, at least in Europe.

TRADE OF HERBS

Actors and Process

The existing hierarchy of herbs business channel looks as follows

- | | |
|---------------|--|
| — Collectors | — villagers |
| — <i>Naik</i> | — leader |
| — Contractor | — the local dealer who gets the order from the business men from Kathmandu |
| — Businessmen | — from Kathmandu |

The businessmen give the consignment order to contractors providing money in advance. The contractor again delegates the order to concerned villagers along with money in advance. Sometimes, there is also another actor between contractor and the villagers, known locally as *Naik* (leader). They are hired usually in places far from the contractors' place. The villagers deliver the goods to the contractors or *Naikes*. In places far off, the *Naikes* also arrange for transporting the goods to the contractor.

The exact amount of time required for harvesting a certain quantity of particular species is difficult to estimate owing to the nature of the process involved in harvesting. Once the contractor informs the collectors of the required quantity, all the family members constituting old men, women and children start collecting them. At times, the collection takes place on a casual basis coinciding with other chores, such as bringing fuel-wood, collecting fodder, looking after livestock, etc. During the peak season, the whole family goes to find *Chiraito*. According to one estimate, a person can collect maximum of 1 *dharni* (2.4 kgs) of male *Chiraito* or 10 *dharni* of female *Chiraito* in one day (8 hrs). The maximum quantity of *Chiraito* ever supplied by one family is 40 *dharni* per season.

The contractor delivers the consignment at different points of the road and road head of the district. It is the responsibility of the businessmen from Kathmandu to take care of the consignment beyond these points. The businessman arranges transportation to Kathmandu. The administrative formalities including the royalty payments are taken care of by the businessmen.

Total Trade

The most commonly traded herbs, as shown by the trend for the last 7 years (1985-1991) is *Chiraito* (*Swertia* spp.), followed by *Bojho* (*Acorus calamus*) and *Mayto* (*Rubia cordifolia*). Others include about 14 different species. It is shown in the Fig. 2 and Tables-2, 3 and 4.

Total amount of royalty collected over the same period was Rs. 2,71,675.57 at constant price 1991, is given in Table-3.

Metric Ton

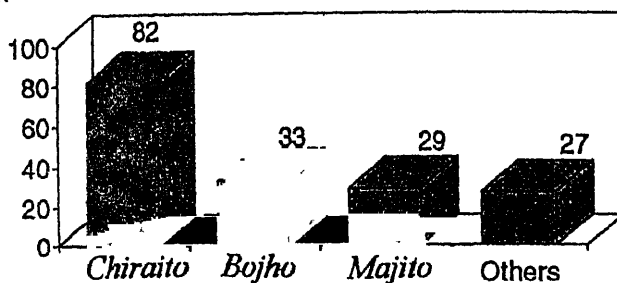


Fig. 2: Amount of Herbs species traded to Kathmandu (1985-1991)(Official Record)

Source District Forest Office, Dolakha, 1992

Table-2: List of Main Herbs (Medicinal Plants) Traded from Dolakha District

S N	Nepali Name	Botanical Name	Royalty rate Rs /kg in 93/94
1	Chiraito	<i>Swertia</i> spp	2 18
2	Bojho	<i>Acorus calamus</i>	1 46
3	Majhuto	<i>Rubia cordifolia</i>	1 15
4	Sunpati	<i>Rhododendron anthopogon</i>	4 85
5	Satuwa	<i>Paris polyphylla</i>	1 46
6	Dalchini	<i>Cinnamomum zeylanicum</i>	2 18
7	Kutki	<i>Picrohiza kurroa</i>	4 38
8	Bishphej	<i>Polypodium vulgare</i>	1 46
9	Nagbeli powder	<i>Lycopodium clavatum</i>	12 00
10	Jatamanshi	<i>Nardostachys jatamansi</i>	7 00
11	Pakhanbed	<i>Bergenia ligulata</i>	2 33
12	Indreni seed	<i>Citrullus colocynthis</i>	4 50
13	Padamchal	<i>Rheum emodi</i>	---
14	Kokale	<i>Fritillaria cirrhosa</i>	---
15	Jhyau (Bishkhel)	<i>Lichen</i> spp	10 00
16	Bikh	<i>Aconitum spicatum</i>	2 18
17	Asuro	<i>Adhatoda vasica</i>	---

Table-3: Medicinals plants which have recently been Banned for Export only

S N	Nepali Name	Botanical Name
1	Jatamanshi	<i>Nardostachys jatamansi</i>
2	Sugardhawal	<i>Valeriana wallichii</i>
3	Sugaudhakokil	<i>Cinnamomum glaucescens</i>
4	Jhyau	<i>Lichen</i> spp
5	Sarpagandha	<i>Rauwolfia serpentina</i>

Table-4: Medicinal plants which have recently been banned for collection as well as export

S N	Nepali Name	Botanical Name
1	<i>Yarsagumba</i>	<i>Cordiceps sinensis</i>
2	<i>panchaunle</i>	<i>dactylorhiza hatageria</i>

Table-5: Royalties collected in the period 1985 - 1991 by District Forest Office, Dolkha

S N	Species	Royalty collected
1	Chiraito	Rs 1,49,854
2	Bojho	Rs. 38,918
3	Majito	Rs 27,697
4	Others	Rs 55,204
	total	Rs 2,71,675

Table-6: Relative Gross Profit (Nepali Rs) gained by various actors out of 1 *Dharni* of (a) *Chiraito* (male) and (b) *Majito* (Based on 1992 data)

Actors	Cumulative Price (Rs)	Share of gross Profit (Rs)	% of total gross profit	Investment
(a) Male Chiraito (<i>Swertia</i> spp)				
Collector	100	100	55.5	9 hrs labour
<i>Naik</i>	110	10	5.5	Collecting material from collector and giving to contractor
Government		11.40		Royalties & sales
Contractor	180	70	39.0	Mediating between <i>Naik</i> /collector and businessmen
(b) Majito (<i>Rubia cordifolia</i>)				
Collector	20	20	42.0	3 hrs of labour
<i>Naik</i>	22	2	4.0	Collecting materials from collector and giving to contractor
Government		3		Royalty, sales tax
Contractor	48	26	54.0	Mediating between <i>Naik</i> /collector and businessmen from KTM

Relative Profits

Table-5 shows the relative gross profit gained by various actors based on the two case studies: 1 *dharni* (2.4 Kg.) each of *Chiraito* and *Majito*.

The profit margin of *Naik* is normally 10% of what the collectors get. The price for the same species can vary widely even within a specific area. Competition is increasing among contractors and *Naikes* specially in accessible areas. Hence, the price received by the collectors is being gradually increased. In 1992, collectors got Rs. 120/- *dharni* of *Chiraito*. This was a substantial

increment compared to Rs. 60/- *dharni* that they used to get a couple of years ago. Some of the contractors even offered to give Rs. 140/- *dharni*, if the collector could collect more than 10 *dharni*.

The share of profit for the contractors ranges from 80% to 130% in comparison of collector's profit without monetary investment except some mediating time. For instance, the contractor gets Rs. 180 per *dharni* of *Chiraito* but he pays the collectors somewhere around Rs. 100 (Rs. 120 from this year). Similarly, the contractor gets Rs. 48 per *dharni* of *Majuto*, but he pays only Rs. 20 per *dharni*.

Harvesting Practices of Herbs

It is necessary to take prior permission from DF Office to collect herbs from the forest. Local contractors or businessmen usually take collection permission from September to October. Actually in practice, collectors harvest the herbs during the early period of growth even before the harvesting permission has been obtained. They store them in their house or at the *Naikes* house, then the contractor applies for collection and later for trading permission to DF Office. Most of the herbs are collected before their maturity because there is competition among the collectors. Therefore, they do not wait until plant's maturity. In case of *Swertia* spp., almost all plants are collected in July-August, which however flower and fruit in October-November only. The collectors are mainly relatives and friends of local contractors and *Naikes*. Thus, the harvesting and trade is confined to small groups having close association. The contractors are mainly interested in low volume-high value herbs which is indirectly depleting the species availability because it costs less for transportation, is easy for handling and smuggling and for maximization of profits.

POLICY, LEGISLATION AND MARKETING

The new Forest Policy (1990) states that where forest users wish and are able to manage the government forests in a sustainable way, the use and management rights can be officially handed over by the District Forest Office to Forest User Groups. The Forest User Group can then harvest any forest product according to the approved Operational Plan without requesting for harvesting permits or payment of Royalties. The new Forest Act (1993) also has such a provision. However, the old Forest Rules and Regulations have to be revised to fit with the new Act. These have still not been promulgated. Hence, to-date there is some confusion over the new potential rights of forest users, particularly regarding products which are traded outside the district. Nevertheless, a number of villagers have in the recent past totally protected the forests which they hope to have soon be officially handed over to them, with the aim of harvesting the products,

including *Daphne* and medicinal herbs in a way which increases in the sustainable production. They also hope to increase the degree of local processing and increase the profits to Forest User Groups by linking more directly with Kathmandu and overseas markets.

DISCUSSION AND RECOMMENDATION

- 1) The District Forest Office has scarce information about the resources. The data available on *Daphne* is based on inventories in some selected areas carried out about 10 years ago. The forestry officials have almost no idea of herbs resources, both in terms of type and the growing stock available in this district. In such cases, one cannot say exactly which species is depleted or when it is going to be depleted given the present pace and practice of harvesting. Once it is known, this will pave the way for making a management plan for these resources. Therefore, it is recommended that a resource inventory of both *Daphne* and herbs species should be done in potential areas of Dolakha and Ramechhap District, e.g., where they are being harvested.
- 2) The new Forest Policy of Nepal (1990) has given highest priority to manage remaining forests through a community approach. The interest of people to take near-by forests for management is increasing fast and the experience of community forestry during the past few years has shown positive results for the sustainable development of the forestry sector in Nepal. Therefore, it can be strongly recommended that the cultivation, harvesting, and trade of *Daphne* and medicinal plants, should be incorporated in community forestry management in order to ensure a long term benefit to the community. This is particularly so, since the government capacity to take on the management function has been non-existent (e.g. staff level very low, little interest). The Forest User Groups will require technical support to help them to manage the NTFPs, amongst others, in such a way that production is increased and in a sustainable way.
- 3) There is a long route consisting of different actors involved in this trade, and middlemen are certainly reaping more benefits than the collectors. The reason is that the collectors are mainly from remote areas, mostly illiterate and hesitant to deal with officials and far from national, let alone international, market system. Therefore, an extension programme for making the collectors aware, is expected to ensure more benefits to them, and this should include processing and marketing training, as well as help with loans from banks. Improved quality control is required. This, plus marketing closer to harvesting and production would enable price reductions and more competitive products on the international market.

- 4) Current practice of collection and trade is primitive in nature and is mainly based on individual schemes. What lacks at the moment is some sort of mechanism to bring all the collectors together and come to a common consensus regarding the pattern of practices to be adopted in future. Since these collectors are not organized at the moment, it would not help if only few persons realize the gravity of the problem on their own and try to change the traditional practices into the recommended one. Therefore, there is a need for an organised forum of these collectors, where the harvesting pattern and techniques could be discussed and consensus reached upon. This is potentially possible through the Forest User Group concept, from which co-operative development can be promoted

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Section 8

**INSTITUTIONAL ASPECTS
OF NTFP COLLECTION**

Institutional Aspects of NTFPs Collection, Processing and Marketing

A.P. Misra

COLLECTION AND MARKETING OF NTFPs PRIOR TO 1976

The tribals have right to collect NTFPs. Prior to 1976, i.e., the year before the creation of Gujarat State Forest Development Corporation Ltd (GSFDC), the NTFPs were sold by auction to the private purchasers who, after paying a small price, collected the NTFPs from the forest areas. This system was prevalent for a long time as NTFPs were not considered important, at least from the revenue point of view. Thus, the collection and marketing of NTFPs remained totally with the private purchasers. It is said that Charonji (*Buchanania lanzan*) collected by tribals was exchanged by giving equal quantity of salt. The exploitation of the tribals used to take place by under-weighing and paying a token amount only.

COLLECTION AND MARKETING OF NTFPs (OTHER THAN TIMRU) AFTER 1976

Timru leaves (*Diospyros melanoxylon*), Mahua flower (*Madhuca latifolia*), Mahua seed and gums are nationalised and only GSFDC is empowered to collect and market them. The Timru forms the major bulk of the business of the GSFDC, and is, therefore, dealt with in greater detail in this paper. In case of other Nationalised or Non-nationalised NTFPs, a large number of collection agents are appointed by the GSFDC who are empowered to collect the NTFPs (other than Timru) by the payment of collection rates fixed by the GSFDC. These collection rates are fixed by a committee which has representatives from the tribals and also from the business community. This committee also fixes the collection rates for Timru (*Diospyros melanoxylon*). A list of the Nationalised and Non-nationalised NTFPs is provided in Table-1.

The agent keeps a record of collections and the payments made to the tribals. The NTFPs are transported to the godowns of the GSFDC from agents' shops for further selling the same. The sales are advertised in the newspapers and open auctions are conducted to get competitive price.

ANNEXURE - I

Table-1: List of NTFPs Collected by GSFDCL Limited along with their Botanical Names, Average Annual Production, Uses, etc

Sl. No	Local Name	Botanical Name	Average Annual Production in (Qdts)	Uses
1	2	3	4	5
Nationalised				
1	Timru leaves	<i>Diospyros melanoxylon</i>	3,00,000 (Std bags)	Beedi making
2	Mahua flowers	<i>Madhuca indica</i>	66,000	Alcohol and cattle feed
3	Doli (Mahua seeds)	<i>Madhuca indica</i>	10,000	Soap making, mixing with vegetable oil
4	Kadaya Gum	<i>Sterculia urens</i>	150	In ice-cream, jelly, denature as adhesive
5	Dhavada Gum	<i>Anogeissus latifolia</i>	60	Edible gum, used in dyeing & pressing
6	Baval Gum	<i>Acacia arabica</i>	300	Adhesive and as edible gum
7	Moina Gum	<i>Garuga pinnata</i>	60	In cloth sizing and for making coir
8	Salai Gum	<i>Boswellia serrata</i>	300	In varnish and paints, dhoop and agarbatti making
9	Gugal Gum	<i>Commiphora wightii</i> (C mukul)	100	As essence and fixative in perfumery, dhoop and in ayurvedic medicines
10	Prosopis Gum (Ganda baval)	<i>Prosopis juliflora</i>	4,500	In tobacco for zarda In hing dilution and in crackers
11	Gorad Gum	<i>Acacia senegal</i>	20	Edible, used for sizing Nepal paper
12	Khair Gum	<i>Acacia catechu</i>	20	Edible, medicinal
13	Khakhar Gum	<i>Butea monosperma</i>	20	In preparation of medicines on worms
Non-Nationalised				
1	Puwad seeds	<i>Cassia tora</i>	12,000	Cattle feed, ayurvedic medicines on skin diseases, decoction as aphrodisiac
2	Amla	<i>Embellica officinalis</i>	400	In trifle, chavanprash and ayurvedic medicines
3	Mushi	<i>Chlorophytum tuberosum</i>	20	Tonic and vitalizer

Table 1: (Contd.)

Sl No	Local Name	Botanical Name	Average annual Production in (Qtls)	Uses
1	2	3	4	5
4	Charoli (Chironji)	<i>Buchanania lanzan</i>	50	Used in sweets and foods
5	Honey		1,000	Tonic, medicines, cough mixers
5	Karanj seeds	<i>Pongamia pinnata</i>	1,200	Oil in soap making and skin diseases
7	Roshia grass (oil)	<i>Cymbopogon martinii</i>	1,000	As fixative in attars, medicinal oil on arthritic troubles
			(grass)	
8	Aritha	<i>Sapindus emarginatus</i>	200	Herbal shampoo, cleaning ornaments
9	Harda	<i>Terminalia chebula</i>	2,000	Trifla, medicines, tanning
10	Baheda pulp	<i>Terminalia belirica</i>	1,500	In trifla, tanning
11	Sadad bark	<i>Terminalia alata</i>	1,000	For extraction of oxalic acid
12	Indrajav	<i>Holarrhena antidysenterica</i>	30	Ayurvedic medicines
13	Wax		100	In pain balms, creams & medicines
14	Ratanjyot (nut) (Physic nut)	<i>Jatropha curcas</i>	200	Oil in soaps & as fuel (in place of diesel)
15	Chanothi (Red)	<i>Abrus precatorius</i>	20	In medicines, gold weighing
16	Chanothi (White)	<i>Abrus precatorius</i>	0.5	In medicines
17	Neem seeds	<i>Azadirachta indica</i>	1,500	Oil in medicines, and skin diseases
				Oil cake as fertilizer
				Oil in skin diseases
18	Darudi	<i>Argemone mexicana</i>	400	Medicines
19	Vadavadia seed	<i>Gloriosa superba</i>	---	Ayurvedic medicines on worms and in fever
20	Kachka seeds	<i>Caesalpinia crista</i>	200	Tonic, vitalizer, aphrodisiac
21	Kaucha seeds	<i>Mucuna pruriat</i>	10	Ayurvedic preparations on eye diseases
22	Chumed	<i>Cassia absus</i>	250	Lac polishing, sealing
23	Kusum lac	<i>Schleichera oleosa</i>	30	Oil in soaps & varnish industry
24	Plu seeds	<i>Salvadora persica</i>	300	

(Contd.)

Table 1: (Contd.)

SI No	Local Name	Botanical Name	Average Annual Production in (Qtls)	Uses
1	2	3	4	5
25	Khakhar lac	<i>Butea monosperma</i>	100	Lac polishing, sealing
26	Khakhara leaves	<i>Butea monosperma</i>	1,000	Leaf cup and plate making
27	Kesuda flowers	<i>Butea monosperma</i>	1,500	Dyeing of silk cloth, in snuf, decorations (abroad)
28	Prosopis pod	<i>Prosopis juliflora</i>	4,000	Cattle feed
29	Ashitra leaves	<i>Bauhinia racemosa</i>	20	Beedi making, ayurvedic medicines on gandmala & granthi
For Dhanvantary Project				
30	Galo	<i>Tinospora cordifolia</i>	2	Rasayan churan, ayurvedic medicines
31	Malkangani	<i>Celastrus paniculata</i>	2	Brain tonic
32	Arjun bark	<i>Terminalia arjuna</i>	3	Ayurvedic medicines on heart diseases
33	Ardusi	<i>Adhatoda vasica</i>	10	Cough mixer, medicines
34	Salvan	<i>Desmodium gangeticum</i>	50	Ayurvedic medicines on rheumatic troubles
35	Pithavan	<i>Urtica picta</i>	50	Ayurvedic medicines on rheumatic troubles
36	Shatavari	<i>Asparagus racemosus</i>	100	Tonic, ayurvedic medicines on acidity, ulcers
37	Chitrak	<i>Plumbago zeylanica</i>	100	Appetizer, digester
38	Kutaj kado (Kada chhal)	<i>Holarrhena antidysenterica</i>	1,000	Diarrhoea, dysentery
39	Mamejavo	<i>Eucostema litorale</i>	500	Diabetes, fever
40	Bhangaro	<i>Eclipta prostrata</i>	500	Hair oil, rasayan
41	Gokhru	<i>Tribulus terrestris</i>	1,000	Diuretic, kidney stone, rasayan churan
42	Sankhpuspi	<i>Convolvulus pluricaulis</i>	50	Brain tonic

Plus and minus points of this system are given below in tabular form.

Sl No	Plus Points	Minus Points
(i)	The nationalized items (i.e. Mahua flower and seed; and gums), which form the bulk of the business provide sufficient wages to the tribal community during non-agriculture season	Marketing is difficult due to the highly fluctuating market and perishable nature of the NTFPs
(ii)	A kind of support system for non-nationalized NTFPs is provided	---

COLLECTION AND MARKETING OF TIMRU AFTER 1976

The following system has been evolved for Timru (*Diospyros melanoxylon*) collection and marketing:

- i) collection and marketing by the purchaser,
- ii) collection and marketing by the Co-operative Societies, and
- iii) collection and marketing by the GSFDC.

Advance sale is conducted in the month of November and Timru units are sold at a competitive price. Based on the price received in the open auction, the Co-operative Societies are allotted units at about 25% concessional price. The remaining Timru units are worked by the GSFDC mainly from the point of view of providing wages to the poor section of the society.

The plus and minus points of the three methods are given below in tabular form.

Method of collection and marketing	Plus Points	Minus Points
1	2	3
i) Collection and marketing by the purchaser	a) Due to competition, revenue realisation is high b) The staff is able to concentrate on the collection and marketing of the other NTFPs as work load is considerably reduced c) GSFDC has not to make large investments for payment of collection charges	Private parties get the maximum benefit although the various operations like pruning, collection, drying and bagging are carried out more efficiently by them

(Contd)

1	2	3
ii) Collection and marketing by the Co-operative Societies	Apart from the collection charges, the profits earned are also distributed to the tribal community	Marketing of Timru is a complex process and therefore it is difficult to earn large profits as earned by the private purchasers
iii) Collection and marketing by the GSFDC	The poor section of the society is provided wages and is gainfully employed during non-agriculture season even in poor Timru bearing areas	a) The quality of material is not high and marketing being a complex operation, the profits are low b) Large sums have to be invested to pay the collection charges to the tribals, transport, hiring of godowns, etc

DISCUSSION OF PROBLEMS INVOLVED AND SOME SOLUTIONS DEVELOPED

(a) Problems

Timru has been given maximum attention because profits accruing from the sales of the same forms the major and assured profit to the GSFDC and the profits so earned are utilized for developing the collection and marketing of the other NTFPs which are not economical from the revenue point of view and need support for further development. At present, 55 NTFPs are being collected and need financial support in view of fluctuations in production (due to changes in weather conditions) and also unsteady demand of the market.

The GSFDC has been able to improve the production by adopting better collection techniques and improve storage by training and also by giving adequate collection charges to the tribals. However, in the field of marketing, the situation remains extremely difficult due to a few factors listed below.

- i) *Cheap Imports* Countries of the African continent are able to sell gums to India at almost a throw-away price, resulting in non-selling of Indian gums (as the labour charges in India are higher).
- ii) *Glut in Market* Example of *Mahua* flower (*Madhuca latifolia*) is appropriate. Over production once at least in three to four years occurs, and in turn large quantities of *Mahua* flowers remain unsold.

111) *Unsteady Demand for Foreign Market:* Example of Gum Karaya (*Streculia urens*) is worth studying from this point of view. Large quantities were exported a few years back but due to various reasons, the demand has dropped low

(b) Solution

1) *Semi-processing of NTFPs.* The NTFPs collection and its marketing, ideally should be done in such a manner so as to provide maximum benefit to the tribals and make best use of this natural resource, in making articles of utility. In the present system, so far as collection of the NTFPs is concerned, the tribals get wages which are commensurate with the market of the NTFPs. NTFPs form raw material base for a large number of manufacturing units which prepare a range of products for daily use, e.g., bidi, cooking oil, wine, herbal medicines, etc., and the present system fulfils this requirement also. However, the major portion of profits go to the processor of these natural products, as they carry out value-addition operations. Since NTFPs are perishable, and their storage beyond one season results in deterioration of their quality and hence are less useful in the manufacturing process. In the present context, to make the NTFPs collection activity economically viable as there is a great constraint to sell it in the shortest period to get the best price, it is desirable to semi-processes the NTFPs before marketing.

11) *Solutions under Implementation* In order to make further improvements in providing more collection charges to tribals and carry out value-addition, grading and processing has been taken up on a large scale by GSFDC in the last three years.

Grading: Grading is being done for a number of NTFPs and the details are given in Table-2. Higher collection rates are given to the tribals for better grade NTFPs. During sales, higher rates have also been received. As the present market is quality-conscious, hence grading is essential for customer's satisfaction and indirectly providing higher collection rates to the tribals.

Processing One small processing unit 'DHANVANTARI' has been established by the GSFDC which processes a number of items. At present, Ayurvedic preparations are made and are being successfully sold in the market by competing the well established Private Sector. A perusal of Table-3 would reveal that by processing the NTFPs, value-addition takes place to a great degree and thus the GSFDC can pay higher collection charges to the tribals.

CONCLUSION

The significance of the active participation of tribals to preserve the forests is well realised and the increasing role of 'Joint Forest Management' is being

Table-2: Collection Rates for Different Grades of Some NTFPs

S No	NTFP	Collection rate (Rs per Qtl)		Sale rate received (Rs per Qtl.)
1	Kadaya Gum (<i>Sterculia urens</i>)	Grade - I	3000	5750
		Grade - II	2600	4400
		Grade - III	2000	3620
2	Baval Gum (<i>Acacia arabica</i>)	Super Grade	2500	4000 (retail)
		Grade - I	1500	2900
		Ungraded	1000	2600
3	Gugral Gum (<i>Commiphora wightii</i> , <i>C mukul</i>)	Super Grade	5000	8850
		Grade - I	4500	8300
		Grade - II	3000	6700
		Grade - III	1100	3750
4	Prosopis Gum (<i>Prosopis juliflora</i>)	Grade - I	700	1850
		Grade - II	550	900
5	Musli (<i>Chlorophytum tuberosum</i>)	Super Grade	25000	28000(retail sale)
		Grade - I	22500	{ Musli powder manufactured at Dhanvantari
		Grade - II	11000	
		Grade - III	8500	

more actively practised. In this context “Grading” and “Processing” of NTFPs at the village level is most beneficial not only to tribals from the employment generation point of view but also from the best utilisation of NTFPs resource view point. The GSFDC can take up further processing and selling in the market of NTFP items. In author’s opinion, the concept of ‘Joint Forest Management’ can succeed best by raising NTFP species and processing the NTFPs in the village itself. Marketing can be done by the GSFDC.

Table-3: Collection Rate and Value after Processing

Sl No	NTFP	Collection rate in Rs per quintal					Value after processing in kg	
		1990	1991	1992	1993	1994	Name of product	Value in Rs
1	2	3	4	5	6	7	8	9
1	Amla (<i>Embllica officinalis</i>)							
	Ungraded	300	350	500	400	400	Amla powder	40
	Super grade	---	---	---	600	600	Amla tablet	110
2	Aritha (<i>Sapindus emarginatus</i>)							
	Ungraded	250	250	400 to 450	500	500	Aritha powder	40
	Super grade	---	---	---	800	1200	---	---
3	Harda (<i>Terminalia chebula</i>)							
	Ungraded	250	250	250	180	180	Harda powder	40
	Super grade	---	---	---	300	500	Harda tablet	110
4	Baheda (<i>Terminalia bellirica</i>)	100	100	100	200	200	Baheda powder	40
5	Kaucha Seed (<i>Caesalpinia crista</i>)	500	500	500	500	600	Kaucha powder	45
6	Indra jav (<i>Holarrhena antidysenterica</i>)	500	500	600	700	700	Indrajav powder	55

(Contd)

Table-3: (Contd.)

1	2	3	4	5	6	7	8	9
7	Raw Honey	900	900 to 1100	1100 to 1300	1500 to 1800	1800	Processed honey	50
8	Guggal (<i>Commiphora mukul</i>)							
	Grade - I	2600	3000	4000	4500	4750	Trifla guggal	240
	Super grade	---	---	---	5000	5500		
9	Musli (<i>Chlorophyllum tuberosum</i>)							
	Grade - I	12500	17500	22500	22500	22500	Musli powder	400
	Super grade	---	---	---	25000	30000		

Forest Nistar (with Special Emphasis on Bamboo) in Madhya Pradesh—Challenges and Opportunities

B.M.S. Rathore

FOREST NISTAR

In Madhya Pradesh, Bamboo makes one of the most important forest produces under Nistar provisions. Small timber (poles 21-60 cm girth) and fuel-wood constitute the other major provisions under Nistar supplies. As per the definition agreed upon by Forest Nistar Committees, M.P., set up in 1958, the Forest Nistar should be defined and understood to mean the requirement of forest produce by an agriculturist for bonafide domestic and agricultural purposes and not for sale, barter or export.

FOREST NISTAR — HISTORICAL PERSPECTIVES

The management of forests in the country in pre-colonial period was based on social management by communities. The villagers enjoyed customary rights of use, governed by and regulated by community sanctions. Subsequently, it got shifted to the hands of the provincial British Government rulers of feudatory states, zamindars and proprietors known by various names. The British administration guided by commercial/industrial interests went ahead to set aside exclusive reserves to meet the growing demand of railway and world war requirements. It would be seen that act of reservation started with framing of first Indian Forest Act, 1865. However, the act was found to be inadequate on several scores. As Dr Brandis puts it, "Act of 1865 is incomplete in many respects, the most important omission being the absence of all provisions regarding definition, regulation, commutation and extinction of customary rights". It followed a heated debate over separation of rights/privileges, culminating ultimately in Forest Act of 1878. The Act recognised reserve forests under total state control, based on permanent settlement of rights barring in exceptional cases (forest villages). While the protected forests would have the rights recorded but not settled which can be exercised till a time of settlement.

It would be seen that the rights and concessions granted in respect of fuel-wood, timber, grazing, etc., were confined only to the villagers in and around the periphery of forests and generally only non-reserve forests were open to the

exercise of these rights and concessions. Rights of commutation for nistar within reserve forests were restricted to inhabitants of forest village only, which was brought under a system of licence in 1872 and the facility extended to unreserved forests as well, under the control of Deputy Commissioner.

The bigger feudatory states, small zamindar, jagirdars had the situation drawing parallel to British administered areas. The old state of Madhya Pradesh, however, had different constituent units.

In Mohokoshal regions, i.e., old C.P. and Berar, no rights were accorded to the people for nistar produce and grazing in reserve forests. Only unreserved forests were open for nistar right under Land Revenue Act, 1917. Records of rights were maintained (waji-ul-arz) by revenue officers. These forests in 1958 were brought under protection, under section 29 of India Forest Act, 1927. A large area of such forests being the ex-malgujari forests.

In Madhya Bharat region too, there were no rights in reserve forests. In old Gwalior State, forests within 3 miles of the boundary of reserve forests were considered protected and people were given nistar rights. The jagirdari, zamindari and malgujari forests provided nistars to the villagers on the same basis as the rights available in the protected forests of the erstwhile Gwalior State. All such forests were declared protected in 1955, maintaining the status-quo as far as the nistar rights were considered. Vindhya Pradesh State was constituted in April 1948 consisting of Baghelkhand and Bundelkhand regions. Rewa was the largest state in Baghelkhand. It recognised two categories of forests, reserved and general. Nistar was restricted to general forests only.

Bhopal State, the fourth constituent of new M.P. recognised three categories of forests; state forests, rulers-private forests and revenue forests. The first two categories were reserve while the villagers were given rights in revenue forests. Bhopal State-land Revenue code gave more extensive rights of nistar and grazing in reserve and revenue forests.

Sironj sub-division makes the 5th constituent in new state of M.P. It had two types of forests, reserve and unclassified. Both types gave nistar facilities to villagers.

THE NEW STATE OF MADHYA PRADESH

By the time the new state of M.P. emerged on the map on November 1, 1956, the problem of nistar had already taken a serious dimension. Nistar requirements of local villagers till such time were being largely met from unreserved forests (a major part of it being the malgujari and ex-proprietary forests). In early fifties (abolition of proprietary rights management of forest department) there was a massive destruction of forests leaving most of the areas in a badly depleted condition. With the increase in demand and depletion of resources, the pressure on Government mounted. In the old Central Provinces and Berar State,

cabinet meeting chaired by the Chief Minister was held in June, 1956, at Pachmari, to review the nistar arrangements and hardships being faced by the people in meeting these requirements. The cabinet decided that if it is not possible to meet the nistar requirements from malgurjari forests then arrangements be made to fulfil the requirements from adjoining reserve forests. In Madhya Bharat area too, the forest department started opening new depots where from villagers can obtain their nistar requirements. In spite of such measures, resentment concerning nistar continued. One reason of the resentment being that the people not living near the forest could not be covered under existing arrangements. Another problem related to the fact that in the state of M.P., facilities of nistar differed in its constituent units and there was no uniform policy (e.g. Government policy of 1958 emphasised that all the necessary nistar requirements of the cultivators be fulfilled, as far as possible from those forests that are most conveniently located). The policy, however, admitting the problem, narrated briefly the steps to be initiated to overcome it in the initial stages. It declared constitution of forest nistar committee to go into the various issues concerning forest nistar. Some of the steps suggested by the nistar policy committee are listed as under

- i) All nistar forests be worked under a working scheme,
- ii) For such forests where no working scheme existed, the forests be worked on the basis of ad hoc felling areas and the work be done departmentally,
- iii) The material be supplied from nistar depots. For material harvested from Reserve Forest, the royalty be charged only fifty per cent of the normal, whereas for the material extracted from Private Forests or unclassified forest, the concession would continue, as in past, and
- iv) The government also decided to open up commercial depots for areas where no forests existed and the rates in these depots were 80% of the market price (royalty), to which harvesting and transportation expenses were to be added.

The forest nistar committee constituted under the Chairmanship of the late Forest Minister Shri S.N. Shukla submitted the recommendations to Government on 23rd October, 1961. A few of these recommendations have since been acted upon. However, an over all picture with respect to nistar arrangement remained unsatisfactory. Some of the nistar problems are listed as under

- i) Lack of clear cut definition of nistar and nistaries,
- ii) No linkage of nistar concessions enjoyed by the beneficiaries and the forest management problems,
- iii) Gradual reduction of nistar forests over the years coupled with increase in population, thus leading to serious shortfall in supply,
- iv) No legal framework for nistar provisions,
- v) No clear cut guidelines for opening up various type of depots like nistar/consumer/commercial depots and lack of adequate staff,
- vi) No grazing control in practice, and

viii) Lack of political will to take a long term view of nistar and forest development.

The Government vide their memo No.7/23/79/3/10 appointed a committee of forest officers to go into problems of nistar under the chairmanship of CCF (Dev). The report and the discussions that followed afterwards tend to agree as under:

- * Nistar provision be restricted to the villages up to 5 km from forest periphery and such villages be given nistar produce from nistar depots at 50% royalty added to the actual harvesting and transport cost.
- * In between 5–30 km distance from forest, the villages be given forest produce at consumer rate @ 80% royalty plus harvesting and transport cost, subject to produce availability.
- * Commercial rates be applied for villages beyond 30 km zone and for municipal areas. Forest Department may provide the forest produce from such depot based on availability, and the rates would be as per prevailing market rates. Timber provisions per person in such areas not to exceed 0.5 cmt/annum.
- * In case of bamboo for basod (bamboo workers) families, the rates would be at par with local villages, i.e., 50% royalty + actual harvesting and transportation cost.
- * It also laid down norms for providing fuel-wood to various category of areas. It recommended opening of fuel depots in areas exceeding a population of 5000. Fuel stack provisions to nistaries and consumers at different rates were provided for.
- * On grazing concessions, the committee observed that, there should be a ban on trans-migratory cattle. The department was supposed to organise rotational and controlled grazing in open areas.
- * The committee also felt that there is a need to calculate concessions given to various categories of people in terms of money and to reflect the same in forest revenue.
- * There was a question of introducing Forest Nistar Act, so as to accord legal status to nistar provision.

However, these recommendations could hardly be acted upon. Four decades following re-organisation of Madhya Pradesh, the nistar still remains a problem area and the situation is going from bad to worse, as the production of nistar produce could hardly keep pace with growing demand.

JOINT FOREST MANAGEMENT AND NISTAR

People will be actively involved in the programme of protection, conservation and management of forests, states the new forest policy of 1988. The policy

makes it explicitly clear that 'holders of customary rights and concessions in forest areas should be motivated to identify themselves with the protection and development of forests from which they derive benefits. The rights and concessions from forests should primarily be for the bonafide use of the communities living within and around forest area especially the tribals'.

The policy further states that 'The requirements of tribals and the poor living within and near forests for fuel-wood, fodder, MFP and construction timber should be the first charge on forest produce'. Following the new mandate given by 1988 forest policy, the Govt. of India, in its circular of June 1, 1990 laid down detailed procedures for the involvement of local communities and rehabilitation of degraded forests and sharing of usufructs. State Govt of Madhya Pradesh in its circular dated December 10, 1991, paved the way for organising village committees at local levels in areas sensitive to damages (village forest protection committees) and the degraded areas (village forest committees). Thus the decade of nineties open up a new chapter in the annals of forest management which raised many new issues including those, having bearings on nistar policy.

The new approach of JFM with local level village committee is based on the assumption that given the right approach and environment, the local villagers or group of villagers would start protecting and nurturing the area falling in their close vicinity and from such area they would be entitled to usufruct sharing and other concessions. This obviously means exclusion of villages not in the close vicinity of forests.

One of the major problems with nistar has been lack of linkages whatsoever of the nistaries and the forests where from they have been driving the nistars. The local villagers hardly felt any stake in preserving the forests adjoining their village as the nistar provision applied equally to all category of villagers whether the village is in close proximity of forest or a distant one. As the new chapter of JFM unfolds, it would be easier to find much more explicit linkages between the local village nistars and the forest protection and development.

As per the mandate given by the national forest policy, 1988, with respect to the people living in and around the forests and coupled with State Govt Circular on JFM, it is proposed that the nistar arrangements be suitably modified to cater to the first charge of local communities. Some of the steps that are immediately required for serious consideration with respect to nistar provision in light of changed emphasis are listed as under

- (i) The nistar requirements of poles and Bamboo be made available as a first charge to the people living in and around the forests at a concessional price in lieu of their involvement in the protection and development of forests through village committees. Under the arrangements where VFPC has been formed, the actual bonafide requirement of such forest produce be made available at a rate which would include only harvesting and transportation charges (the distance be kept minimum)

The fuel-wood to these villages likewise be provided from coupe area at concessional rate in form of fuel stacks (nominal royalty + harvesting charges). Extraction of fuel-wood by head loads be allowed free of cost for the bonafide consumption.

- (ii) People with 5–8 Km zone from forest periphery, be provided nistar produce depending on availability, at consumer price which is 50% of royalty and actual harvesting and transportation to the depots. Fuel-wood in the form of stacks be supplied to the villagers at 50% of royalty + actual harvesting cost.
- (iii) Commercial rates be charged from villages beyond above mentioned zones and for the municipal area. Such rates would be the prevalent market rate and the forest produce would be kept as per availability in the commercial depots. Fuel-wood at such depots may be sold at 80% of the market rate.
- (iv) For the Basods, (Bamboo workers) the rates charged should be 50% of the royalty + actual harvesting and transportation charges. However, supply of bamboo to Basods be made after taking care of the local villagers requirement
- (v) The villages be thus categorised as shown above in I, II and III zone
- (vi) Grazing be regulated as per the carrying capacity of forests. The village committees be encouraged to prepare grazing plan for the area of their control. The first charge of grazing would be of villagers living in and around the forests (upto 5 km) in lieu of their involvement in the protection and development of forests. The grazing plan should resort to rotational and controlled grazing.
- (vii) In order to give legal framework to the nistar provision, the Govt. may think of passing an act so that misuse of nistar is minimised

NISTAR ARRANGEMENT VS. JOINT FOREST MANAGEMENT: COMING A FULL CIRCLE

As pointed out earlier, one of the major problems concerning nistar has been absence of any stake or vested interest of the nistaries in the forest area where from they drive it. This arose mainly due to inclusion of almost any village (irrespective of location in the nistar arrangement (though it had no legal basis but rather a popular move). This not only alienated the local villagers living in and around the forests, but at the same time placed a much heavier demand on dwindling forest resource thus leading to dissatisfaction of one and all. In terms of pricing of nistar produce, a poor tribal living in and around the forest is supposed to pay the same price, as an agriculturist from non-forest area in plains. Given the poor purchasing capacity and dire needs, this segment of population assume a defacto control of situation. It seems that we have come a full circle.

At the turn of the century, the nistar concessions were granted to the people living in and around the forests and recorded in wazib-ul-arz (record of customary rights). Under the new mandate of JFM, the arrangements are being sought to be rebuilt with the people living in and around the forests. It would be thus necessary that the proposed change in nistar arrangements are seriously considered at the earliest so that it gives a fair chance for the new approach to succeed.

One of the apprehensions which gets voiced so often is that any such move to restructure the nistar arrangement would be an unpopular move with any Government. This may, however, need not be the case in actual sense. On many occasions in district level committee on nistar, the people's representatives have said in so many words that in the areas away from forest boundaries, the concessional pricing should be done away with, what is required in such areas is that forest produce is made available at competitive prices round the year to the agriculturists. While the department can try its level best to make the forest produces available in these areas, after providing as first charge, to the people living in and around the forests. It would be in the interest of both agriculturists and department that massive agroforestry farm forestry programmes are built in the villages (distant from forests) simultaneously to bridge demand supply gap. In addition to this, the department should facilitate wood substitute in agriculture implements, having linkages with agro-industries. Promotion of energy conservation and alternate energy devices as well should form part of the over-all package.

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Institutional Effectiveness in Procurement and Marketing of Non-timber Forest Produce (NTFP) in Kerala

Philip Thomas and K.C. Sankaranarayanan

The collection of NTFPs is an important component in the economy of the tribal communities. Tribes are considered as the most down-trodden community of the state. They account for 1.10 per cent (3.21 lakh), of the total population of the state (Government of India, census 1991), and are mostly concentrated in the districts of Wayanad and Palakkad. They mainly depend on forest and agriculture for their livelihood. However, the tribal economy is characterised by land alienation, indebtedness, exploitation, bonded labour system and poverty. In order to save the tribals from the exploitative practices of private traders and contractors of forest and to ensure a fair price for NTFPs, the Government of Kerala, as part of Tribal sub-plan, has granted the exclusive right of collection of 120 notified items of NTFPs (KSF SC/ST-DC 1993, Kau & Kirtadas 1984; Gupta & Guleria 1982, Shiva 1992, Campbell 1993) (see Appendix-1) to the Tribal Co-operative Societies (TCS) of Kerala. The present study examines the institutional effectiveness in procurement and marketing of NTFPs in Kerala. The study reveals that the average contribution of NTFPs to the total income of tribal was 58 per cent, although the full potential of NTFPs was not being utilised. The institutions also did not have proper liaison with the demand pockets of NTFPs and the then contractors and private traders still play a pivotal role in the NTFP market in the state. It has also been found that although the system of procurement and marketing through TCS has helped in holding the price line of NTFPs by offering a floor price, there is a lot more to be done to plug the holes in the present system. The paper is divided into two parts — Part-I and Part-II. Part-I — deals with the existing system of marketing arrangement of NTFPs in Kerala, the institutions connected with marketing growth of NTFPs — classified item wise, share of collection charge over sales value, demand pockets of NTFPs and their purchase value of NTFPs etc., while Part-II — thoroughly examines the system at the grass root level.

PART-I : COLLECTION AND MARKETING ARRANGEMENT OF NTFPs IN KERALA

Till 1977-78 (Kerala Govt., 1978), the collection and marketing of NTFPs was

done by the private traders/contractors. They used to auction the forest ranges and employ the tribes to their own advantage, to collect NTFPs. Since 1978, the Government of Kerala, with the objective of improving the socio-economic conditions of tribes, has entrusted the right of collection of NTFPs from reserve forests to TCS and their members at a concessional lease rent. Accordingly, 31 TCS having a total membership of 15210, from the 84 TCS of the state have been exclusively selected for the collection and marketing of NTFPs in the state (KSF SC/ST—DC 1987). As per the system the tribes have no right to make any direct sale to outside parties/institutions. The TCS should collect the entire produce of tribes and market it through the Kerala State Federation of SC/ST Development Co-operative (SC/ST Federation — Apex institution of TCS), Thiruvananthapuram, at a price not below the price fixed by the NTFP committee. The Chief Conservator of forest, the Registrar of Co-operative Societies, the Director of Tribal Welfare, the Secretary, Health Department and the Managing Director, SC/ST Federation are the members of the NTFP committee. The Chief Conservator of forest is the Chairman of the committee. The committee fixes three prices, viz., collection charge, procurement value and sales value for NTFPs. The collection charge denotes the minimum price by which the TCS collect NTFPs from tribes. The Board of Directors of TCS have all the liberty to enhance the rate. Likewise, the procurement value observes the minimum price by which the SC/ST Federation procures the produce from TCS. It is the minimum guaranteed price to TCS. The possible 'sales price' of NTFP by SC/ST Federation is denoted by sales price list. As per the system, 80 per cent of the sales value is given as collection charge to tribes, 15 per cent as commission to TCS and 5 per cent as overhead charges to SC/ST Federation. The Pharmaceutical Corporation (I.M) Kerala Ltd. (Government of Kerala undertaking) is expected to purchase their requirements of NTFPs from SC/ST federation and the rest of the produce are to be sold in the open market on tender/auction basis. Institutions such as Forest Department, Tribal Department, Co-operative Department, etc., are expected to play specific role in the effective collection and marketing of NTFPs in the state. In brief, the co-ordination and co-operation of these institutions are a must to enhance the value of NTFPs and to improve the lot of the most neglected people of the state.

Collection and Marketing of NTFPs in Kerala

As per the estimation of SC/ST Federation (so far no other agencies have tried), NTFPs worth Rs 200 lakhs per year can be collected from the forest ranges of Kerala (SC/ST F 1993). Table-1 depicts the targets and achievements of NTFPs in the state and the share of collection charge over the sales value.

Table-1 shows that in none of the years, the TCS could achieve the target. It varies from 30.88 per cent to 81.92 per cent. Though SC/ST Federation has

Table-1: NTFPs — Targets and Achievements 1982-83 to 1992-93

Year	Target (Rs)	Sales Value (Rs)	Target as % to sales	(Rs in lakhs)	
				Collection Charge (Rs)	Collection Charge as % to sales
1982-83	82	25 32	30 88	17 95	70 89
1983-84	82	34 55	42 13	23 94	69 29
1984-85	82	43 11	52 57	26 70	61 93
1985-86	100	45 93	45 93	31 06	67 62
1986-87	100	34 00	34 00	25 48	74 94
1987-88	100	52 27	52 27	36 43	69 7
1988-89	94	47 27	50 28	31 54	66 72
1989-90	94	47 17	50 18	32 28	68 43
1990-91	94	66 68	70 94	48 00	71 99
1991-92	114	93 4	81 92	55 87	59 82
1992-93	200	149 07	74 54	91 66	61 49

Source Compiled from the records of The Kerala State Federation of SC/ST Development Co-operatives and the TCS of Kerala — 1982-83 to 1992-93

given direction to all TCS that at least 80 per cent of the sales value should be given to tribes as collection charge, it was observed that in none of the years, the TCS has complied with the direction of the Federation. The average collection charge was only 68 per cent of the sales value of NTFPs.

Growth of NTFPs Collection

NTFPs have been broadly classified as Medicinal and Non-Medicinal items. Medicinal items have again been classified as (A) Tuber Crops (B) Root items (C) Fruits (D) Barks (E) Creepers (F) Liquids (G) Seeds (H) Flowers, and (I) Miscellaneous items. The Non-Medicinal items are also classified as (A) Oil seeds (B) Spices (C) Edible items (D) Dye and Paint items (E) Soap and Shampoo items, and (F) Miscellaneous items. The above classifications are mainly based on the various uses of the NTFPs by the demand pockets in and outside the state. The growth of NTFPs collection (quantity wise) for the aforesaid classes is depicted in Table-2.

From Table-2 it can be seen that there was growth in items such as root, fruits, creepers, liquids, flowers and miscellaneous medicinal items. Among the root items, the highest growth was seen in *Sida rhombifolia* and *Desmodium gangeticum*. In fruits, the highest growth was in *Emblica officinalis*. Among creepers, the largest growth was contributed by *Nilgiranthus ciliatus* and *Trichosanthes cucumerina*. Among flowers, the highest growth was noted in *Cinnamomum verum*. The collection of honey (liquids) and bees wax (miscellaneous) also showed an increasing trend.

Table-2: Growth Index of NTFPs — 1982-83 to 1992-93

Sl No	NTFP — classes	Average Collection (kg)	Growth Index (base 1982-83=100)
I	MEDICINAL ITEMS		
A	Tuber crops	36112	39
B	Root items	75068	1556
C	Fruits	88680	101
D	Barks	13552	9
E	Creepers	46316	205
F	Liquids	39902	112
G	Seeds	21453	81
H	Flowers	1812	131
I	Miscellaneous	5714	176
II	NON-MEDICINAL ITEMS		
A	Oil seeds	25004	53
B	Spices	6713	48
C	Edible items	13975	125
D	Dye and paint items	78121	259
E	Soap and Shampoo items	3,69,728	132
F	Miscellaneous	30734	4

Source Compiled from the records of The Kerala State Federation of SC/ST Development Co-operatives and the Tribal Co-operative Societies of Kerala 1982-83 to 1992-93

Note All collection except fruits, are in dry quantities

Among non-medicinal items, growth is seen in Dye and Paint items as well as Soap and Shampoo items and Edible items. In Dye and Paint items, the highest collection was noted in *Canarium strictum* and *Stereospermum colais*. In soap and shampoo items, the largest share was contributed by *Acacia concinna*, whereas in the case of Edible items the major share was contributed by *Garcinia cambogia*. The collection and marketing of oilseeds, spices, tuber crops, etc., through TCS showed a gloomy picture in the state. The researcher did not feel that the collection of these items have come down in the state. These high-value items are still being collected at high rates but due to the low collection charge offered by the TCS, they may be getting marketed through non-co-operative channel by the tribes themselves.

Did the NTFP Scheme Benefit the Target Group ?

As per the direction of SC/ST Federation, 80 per cent of the sale price of NTFP must be given to tribes as collection charge. Table-3 shows that not in any one of the years, the TCS could comply with the direction of the SC/ST Federation, for any of the classified items of NTFP.

It is observed that in the case of the highly demanded items like roots, dye and paints, soap and shampoo, oil seeds, tubers and fruits, the collection

Table-3: Average Collection Charge and Sales Price — 1982-83 to 1992-93

Sl No	NTFP	Average collection charge/kg (Rs)	Average sales price/kg (Rs)	Collection charge as % to sales price
I	MEDICINAL ITEMS			
A	Tuber crops	5 64	10 18	55
B	Root items	1 89	3 5	54
C	Fruits	1 03	1 57	66
D	Barks	1 9	2 67	71
E	Creepers	2.42	3 73	65
F	Liquids	14 88	20 33	73
G	Seeds	3 78	6 04	63
H	Flowers	13 62	18 93	72
I	Miscellaneous	18 83	30 52	62
II	NON-MEDICINAL ITEMS			
A	Oil seeds	1 34	2 74	49
B	Spices	26 4	92 72	29
C	Edible items	7 3	9 76	75
D	Dye and painting items	7 16	13 05	55
E	Soap and Shampoo items	2 70	6 01	45
F	Miscellaneous	3 9	3 43	114

Source · Compiled from the records of The Kerala State Federation of SC/ST Development Cooperatives, Thiruvananthapuram, 1982-83 to 1992-93

charge which the tribe gets is very meagre. These items have a great demand not only from the Ayurvedic industry but also from other manufacturing units in and outside Kerala

Liaison with Ayurvedic Industry

The success of a marketing institution lies mainly on its liaison with the potential buyers of their produce. The effectiveness of TCS also lies on how far it gets in touch with the demand pockets of their produce, i.e., Ayurvedic medicine manufacturing units and establishments for non-medicinal produce. In Kerala, as per the records of The Kerala Ayurvedic Medicinal Manufacturers Association, there are 880 registered Ayurvedic units in Kerala which comes to about 10% per cent of the total registered Ayurvedic units in the country. The Ayurveda system, which as and on today, makes use of around 700 different kinds of plants, has been a trial blazer, pointing to the unlimited potentialities of the herbal kingdom in alleviating the human sufferings (Panicker 1993). It is estimated that about 550 types of medicinal herbs are available in the forests of Kerala (Ramanathan 1993). But it is a pity to note that out of which we collect only 64 items and altogether the Ayurvedic industry can make use of only 69 items from the 120 - NTFP list. Due to the strict laws and regulations of forest department and the identification problem with reference to some of the

items, most of the NTFP items still remain uncollected. The potential demand of medicinal items of Ayurvedic Industry in Kerala is depicted in Table-4.

Table-4: Potential Demand of Medicinal Items by the Ayurvedic Manufacturing Industry of Kerala

Sl No	Medicinal items	Quantity required (kg)
1	Tuber crops	50518
2	Root items	206889
3	Fruits	27167
4	Barks	36000
5	Creepers	61650
6	Liquids	101500
7	Seeds	26817
8	Flowers	12500
9	Miscellaneous	31333

Source Ramanathan D, "Demand for Medicinal Herbs", paper presented in the Forest Medicinal Herbs Seminar held at Thrissur on 10-5-1993

The researcher found that TCS did not have any liaison with the Ayurvedic manufacturing units of Kerala. While conducting survey among the Ayurvedic manufacturing units, it was found that they even did not collect 1% of their requirement from TCS of Kerala. They depend on some other channels — either directly from tribes or through private traders to meet their requirements. Due to non-co-operation with the Ayurvedic Industry, the real fruits of tribal effort are eaten by the middlemen who now play a pivotal role in the market — first as an illicit procurer of NTFPs from tribes, parallel to TCS, and second as a controller of NTFP trade in Kerala. Really speaking, the TCS have fallen a prey in the hands of these middlemen. Table-5 indicates the magnitude of inefficiency of TCS in tapping the real price of NTFPs (on medicinal items) from the demand pockets of Kerala, i.e., Ayurvedic Industry.

Table-5 brings to light the fact that the middlemen by controlling the market, pocket a huge amount as profit. It may be one of the reasons for the marketing of the NTFPs by tribes directly through middlemen and sidetracking the Co-operatives. It could have been avoided if co-operatives have some knowledge about the potential demand of the produce in the market (so far no survey has been conducted by TCS to know the demand). In brief, the non Co-operative marketing channel is thriving very highly because of the inefficiency of the Co-operative system.

PART-II

The tribes undoubtedly occupy the lowest position among the various under-privileged classes in the state. Centuries long isolated living in forests has denied them the benefits of modern development. The Government, especially

Table-5: Price of NTFPs in the Market and the Sale Price of TCS — A Comparison

SI No	NTFP	X	Y	Z
I	MEDICINAL ITEMS			
A	Tuber crops	42 12	10 18	31 94
B	Root items	9 36	3 5	5 86
C	Fruits	6 75	1 57	5 18
D	Barks	13	2 67	10 33
E	Creepers	21 4	3 73	17 67
F	Liquids	45	20 33	24 67
G	Seeds	21 42	6 04	15 38
H	Flowers	8	18 93	-10 93
I	Miscellaneous	55 17	30 52	24 65
II	NON-MEDICINAL			
A	Oil seeds	9	2 74	6 26
B	Dye & paint items	54 17	13 05	41 12
C	Miscellaneous	9	3 43	5 57

Note X denotes the average unit price offered by the Ayurvedic industry of Kerala during 92-93
 Y denotes the average sales price realised by TCS for NTFP during 1992-93
 Z denotes the price spread (X-Y)

during the plan period, wanted to improve their standard of living, but the real strategy for their development has always been escaping their attention. Even the separate development efforts made by the Government machinery have not paid much dividends.

The establishment of TCS way back in 1956, was a systematic and comprehensive effort for their upliftment. These institutional agencies were able to make some dent particularly on the social welfare front of the tribes. To protect the tribes from the exploitative practices of middlemen, the rights to procure and market NTFPs were granted to TCS in 1978. As seventeen years have passed, since the introduction of the system, it is worth examining whether the system has liberated the tribes from the exploitation of private traders/contractors. It is in the light of the observations made in Part-I, the present study is undertaken with the following objectives:

- i) to examine whether the monopoly procurement and marketing of NTFP through TCS have liberated the tribes from the clutches of private traders/contractors,
- ii) to assess the impact of monopoly procurement and marketing of NTFP through TCS on the tribal economy,
- iii) to analyse the inter and intra difference between tribes and regions in the collections and marketing of NTFPs, and
- iv) to estimate the price spread of NTFP items under co-operative and private marketing channel

METHODOLOGY

The study was based on primary as well as secondary data. Four districts, viz , Palakkad, Thrissur, Kannur and Wayanad, where more than 70 per cent of the total tribal population of the state inhabits, have been selected for the study. Malampuzha TCS, Thrissur Thalappilly TCS, Nedumpoil TCS and Meppady TCS were stratified selected from each district to conduct the study. Hundred tribal households representing 25 tribal households from each society have been selected to study the system at the grass root level. Pre-tested schedules have been employed to collect information from tribes. In order to examine the difference between the price paid by TCS and the private traders, three private traders who deal in NTFP were also selected at random from the nearest market to the societies and tribes ($3 \times 4 = 12$ — private traders). Primary data were also collected from the records of TCS, particularly, the quantity and value of NTFPs and the price offered to tribes for various items of NTFP. The collected data were analysed by employing appropriate statistical tools such as average, percentage indices, etc. The important findings of the study are presented below.

Control of NTFP Collection Through Pass

The forest policy has reiterated the monopoly right of tribes to collect NTFPs from the forests of Kerala. But during the course of the study, it was observed that except Malampuzha TCS, none of the other TCS were issuing passes to tribes regularly and systematically. Pass is the only method to distinguish a person as 'tribe' or 'non-tribe' by forest officials in the forest. As a result of this, it was noted that a lot of non-tribes were also collecting NTFPs unauthorisedly from forests.

Under-equipped for NTFP Collection

The quality and quantity of NTFPs collected have a direct relation to the tools possessed by the tribes for NTFP collection (NTFP Kit). They require items like axe, injathalli, tin, sack, knife, iron bar with pointed edge, etc , for extracting NTFPs from forests. But none of the households were fully equipped with the tools needed for the collection of various types of NTFPs.

Intensity of NTFP Collection

According to 1991 census, about 54 per cent of the tribes were unemployed. Though the tribes could effectively utilise 267 mandays in a year for the collection of NTFPs, none of the tribal communities were fully utilising this potential. The average utilisation was only 57 per cent of the total potential collection days. The rate of utilisation was even below this average in Meppady TCS and

Nedumpoil TCS. If the TCS can take an active interest to collect all items of NTFP round the year, more days of employment and a higher income to the tribes can also be guaranteed.

Illicit Procurement of NTFP

But for the areas of Malampuzha TCS, the private traders were freely opening collection depots or appointing agents near the hamlets of tribes for the procurement of NTFPs. Some of the agents even stay in the forest to collect NTFPs directly from tribes. The forest department officials often close their eyes towards this illicit traffic of NTFPs.

Market Share of TCS

Though TCS were vested with the monopoly procurement and marketing of NTFPs collected by the tribes, it was observed that they could procure only 61 per cent of the total NTFP collections. The presence of private traders in the procurement of NTFPs was almost eliminated by TCS at Malampuzha. But in places like Thrissur Thalappilly, Meppady and Nedupoil, the private traders were virtually monopolising the procurement of NTFPs.

Price Spread

There was significant difference between the price offered by the TCS and private traders in the concerned districts for NTFPs. Though the price fixed by TCS was higher than the price fixed by NTFP committee, the private traders were offering a price even higher than that of TCS. The price spread between the co-operative and non-co-operative channel was 111% for NTFP items with a value of Rs. 15/- and above. The higher prices offered by the non-co-operative channel, the easy marketability of items at the door step itself, getting provisions like rice, betal leaves, beedis, arrack, etc., from the non-co-operative channel on credit basis may be some of the reasons for the leakage of NTFPs to the non-co-operative channel. The price fixed by the NTFP committee was also unrealistic. It was observed that the NTFP committee did not conduct any market survey either to fix the price or to know the use or demand of the produce at least within the state.

Sharing of Price Spread between TCS and SC/ST Federation

During the period 1982-83 to 1985-86, the average share of price spread to SC/ST Federation was 61 per cent and to TCS was 39 per cent. But since 1985-86 the sharing trend has reversed. It has fallen to 19 per cent with SC/ST

federation and 81 per cent with TCS. In fact, the TCS were one way exploiting the tribes. The Apex organisation would have dreamt of passing the spread to tribes by TCS in the form of dividends, but it was observed that except Malampuzha TCS none of the societies did pass the spread to tribes as dividends.

Restrictive Practices of TCS

The TCS were not procuring all the NTFP items which were collected and brought by tribes on the ground that some of the items were not available in marketable quantities. The Malampuzha TCS was restricting the tribes to collect only certain specified items from the NTFP list, though there was potential for the collection of other items in that area also. This practice of TCS put the tribes in considerable difficulty and indirectly helps the survival of private traders who collect all sorts of NTFPs in that area.

Untimely Release of NTFP Advance to TCS

Instances of untimely release of NTFP advance by SC/ST Federation to TCS were also noticed. This results in late commencement of NTFPs collections in the season by TCS and offers vast scope for the private traders to thrive within the foundation of TCS.

Dependence on NTFP as a Source of Income

The average contribution of NTFPs to the total income of tribes was 58 per cent, and the contribution of NTFPs to the total income ranged from 12 per cent in the case of tribes of Meppady to 88 per cent in the case of tribes of Malampuzha. The results clearly indicate that NTFPs have a strategic role to play in improving the economic conditions of tribes.

Inter and Intra Difference in Tribes and Regions in NTFP Collection and Marketing

It is also observed that there do exist considerable difference between and among tribes in the collection and marketing of NTFPs. For, e.g., Thean Kurumars are the experts in honey collection but the Vettu Kurmars do not know even how to climb trees and extract honey. They also live like Paniyars who survive on the collections of roots, tubers, fruits, creepers and other items of NTFP. Regional difference in the availability of NTFPs was also observed. The Thrissur area was vested with more medicinal, dye and paint, soap and shampoo items, whereas the Meppady area (Wayanad) was endowed with liquids (honey), soap and shampoo items. But it is noted that the collection of medicinal items in the areas under study had been given little attention by the TCS.

CONCLUSION

Till the introduction of monopoly procurement and marketing of NTFPs through TCS, the NTFP marketing system was dominated by the private traders to the disadvantage of the tribes. But the present study shows that the TCS were able to market about 61 per cent of the total NTFPs collected by the tribes. In case of Malampuzha TCS, it could eliminate the presence of private traders from the primary market almost completely. Thus, it may be concluded that the monopoly procurement of NTFPs through TCS had liberated the tribes from the clutches of private traders, though not to the extent. Though TCS could break the domination of private traders in the collection of NTFPs but still has to go a long way in ensuring a reasonable price to the tribes. The extent of spread between the price offered by the private and the co-operative channels were to the extent of 111% in the case of high-value items. This calls for a rationale revision of the pricing policy of the NTFP committee. If the NTFP committee can realistically revise the price of NTFPs, that itself will bring more tribes within the fold of co-operative marketing. Another salutary impact of monopoly procurement and marketing of NTFPs through TCS is that the tribes now have a floor price for NTFPs beyond which the private traders cannot depress the price. The average contribution of NTFPs to the total household income of tribes came to 58 per cent. Thus what happens to NTFPs will definitely have an impact on the income-earning capacity of the tribes. The income-earning capacity of the tribes could be improved further had the SC/ST Federation initiated steps to invest in value-addition processes. The gap between potential suppliers and potential demanders of NTFPs will definitely add more hardships to tribes. It must be reduced. Therefore, it is imperative to re-examine the present system and find suitable policies at the institutional level. The monopoly procurement and marketing of NTFPs through TCS can go a long way in improving the socio-economic conditions of tribes through an integrated approach to collection, processing and marketing of NTFPs.

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Appendix-I

List of NTFPs Collected from the Forests of Kerala

Sl No	Malayalam Name	Scientific Name
I	MEDICINAL ITEMS	
	A. Tuber Crops	
1	Adapathiyan	<i>Holostemma annulare</i>
2	Kasthurimanjil/Channkail, Kamdandkoova	<i>Curcuma zedoria</i>
3	Kattinjil (fresh)	<i>Zingiber zerumbet</i>
4	Kattinjil (dry)	<i>Zingiber zerumbet</i>
5	Kacholam	<i>Kaempferia galanga</i>
6	Koduveli	<i>Plumbago zeylanica</i>
7	Kolinji	<i>Andropogon citratus</i>
8	Pada (Kizhangu)	<i>Cyclea pletata</i>
9	Palmuthakkam (kizhangu)	<i>Ipomoea paniculata</i>
10	Thamara (kizhangu)	<i>Nelumbium speciosum</i>
11	Naruneendi/Nannari	<i>Hemidesmus indicus</i>
12	Manjakoova	<i>Curcuma angustifolia</i>
13	Muthanga	<i>Cyperus rotundus</i>
14	Chittaratha	<i>Alpinia galanga</i>
15	Sathavari (Kizhangu)	<i>Asparagus racemosus</i>
16	Vayambu	<i>Acorus calamus</i>
17	Chittelam	<i>Elettaria cardamomum</i>
18	Kattumanjil	<i>Curcuma aromatica</i>
	B. Root Items	
19	Amalapori (red)	<i>Rauvolfia serpentina</i>
20	Amalapori (white)	<i>Rauvolfia serpentina</i>
21	Aadalodakam	<i>Adhatoda vasica</i>
22	Orila	<i>Desmodium gangeticum</i>
23	Kattuthippali	<i>Piper longum</i>
24	Kattumulugu (root)	<i>Piper nigrum</i>
25	Karimkurinji	<i>Nilgiranthus strobilanthus</i>
26	Kattuthulasi	<i>Ocimum canum</i>
27	Kurumthottu	<i>Sida rhombifolia</i>
28	Kumuzhu	<i>Canelina arborea</i>
29	Kodithoova	<i>Tragia involucrata</i>
30	Putharichunda	<i>Solanum indicum</i>
31	Thakara	<i>Cassia tora</i>
32	Moovila	<i>Pseudarthria viscida</i>
33	Cheruthekku	<i>Callicarpa tomentosa</i>
34	Chembarathi	<i>Hibiscus rosa-sinensis</i>
35	Vankurunthottu	<i>Sida carpinifolia</i>
36	Vellathumba	<i>Leucas aspera</i>
37	Thazhuthama	<i>Boerhavia diffusa</i>
38	Veluthaavanakku	<i>Ricinus communis</i>
39	Athuthippali	<i>Rhaphidophora pertusa</i>
40	Ramacham	<i>Vetiveria zizanioides</i>
41	Kattupayar	<i>Phaseolus trilobus</i>

(Contd)

Appendix-I (Contd)

Sl No	Malayalam Name	Scientific Name
C. Fruits		
42	Idampiri/Valampiri	<i>Helicteres isora</i>
43	Kadukka	<i>Terminalia chebula</i>
44	Thettambaral	<i>Strychnos potatorum</i>
45	Nellikka (dry)	<i>Emblica officinalis</i>
46	Nellikka (fresh)	<i>Emblica officinalis</i>
47	Thannikka	<i>Terminalia bellurica</i>
48	Plashe	<i>Butea monosperma</i>
49	Kattupaavakkai	<i>Momordica charantia</i>
D Barks		
50	Elavangam	<i>Cinnamomum cassia</i>
51	Pachotti/Lodha	<i>Symplocos laurina</i>
52	Chappangam	<i>Caesalpinia sappan</i>
E. Creepers		
53	Karimkurinji	<i>Nilgiranthus ciliatus</i>
54	Kattarvazhathandu	<i>Aloe vera</i>
55	Kiriyathu	<i>Andrographis paniculata</i>
56	Keezharnelli	<i>Phyllanthus niruri</i>
57	Kanjunni/Kaithonnipacha	<i>Eclipta alba</i>
58	Padavalam	<i>Trichosanthes cucumerina</i>
59	Neelamar	<i>Indigofera tinctoria</i>
60	Maramanjai	<i>Coscinum fenestratum</i>
61	Chittamruthu	<i>Tinospora cordifolia</i>
62	Changalamparanda	<i>Cissus quadrangularis</i>
63	Garudakodi	<i>Aristolochia indica</i>
64	Jeevakam	<i>Microrhizis wallichii</i>
F. Liquids		
65	Karimthean	(Honey — highly medicinal)
66	Thean (raw)	(Honey)
67	Marottienna	<i>Hydnocarpus pentandra</i> (oil)
G. Seeds		
68	Kazhanji (Kuru)	<i>Caesalpinia bonduca</i> (seed)
69	Kattukurumulagu	<i>Piper nigrum</i>
70	Kanjirakuru	<i>Strychnos nux-vomica</i>
71	Kakkumkai/Parandakkai	<i>Entada phaseoloides</i>
72	Neervalam	<i>Croton tiglium</i>
73	Naikkoranaparippu	<i>Mucuna pruriata</i> (cotyledon)
74	Marottikkuru/Vettikkuru	<i>Hydnocarpus pentandra</i>
75	Mullilamkkuru	<i>Zanthoxylum rhetsa</i>
76	Njaaval	<i>Syzygium cumini</i>
H Flowers		
77	Punnapoovu	<i>Calophyllum inophyllum</i>
78	Chithirapoovu	<i>Euphorbia thymifolia</i>
79	Vayanapoovu	<i>Cinnamomum verum</i>

(Contd)

Appendix-I (Contd)

Sl No	Malayalam Name	Scientific Name
I. Miscellaneous		
80	Peenari/poothavruksham	<i>Nothapodytes foetida</i>
81	Kolarakku	<i>Andropogon citratus</i>
82	Theanmezhughu	(Bees-wax)
83	Kanmadam (I Gr)	Asphaltum
84	Kanmadam (II Gr)	Asphaltum
85	Kadukkathodu	<i>Terminalia chebula</i> (pericarp)
86	Thannikkathodu	<i>Terminalia bellirica</i> (pericarp)
87	Nellikathodu	<i>Emblia officinalis</i> (pericarp)
II NON-MEDICINAL ITEMS		
A. Oil Seeds		
88	Oodakkuru	<i>Sarcostigma kleinu</i>
89	Kattupunnakkai	<i>Calophyllum inophyllum</i>
90	Poovanathari	<i>Balsomodendron myrrha</i>
91	Pollakkai	<i>Anamirta cocculus</i>
92	Nanginkkuru/nangari	<i>Mesua ferrea</i>
93	Palikkuru	<i>Plazium ellipticum</i>
B. Spices		
94	Ealaccal (I Gr)	<i>Elettaria cardamomum</i>
95	Ealaccal (II Gr)	<i>Elettaria cardamomum</i>
96	Ealaccal (III Gr)	<i>Elettaria cardamomum</i>
97	Mattuppal	<i>Ailanthus triphysa</i>
98	Kalpasam	
C. Edible Items		
99	Kaantharimulagu	<i>Capsicum minimum</i>
100	Kudumpuli (fresh)	<i>Garcina cambogia</i>
101	Kudumpuli (dry)	<i>Garcina cambogia</i>
102	Puli (with seed)	<i>Tamarindus indica</i>
103	Puli (without seed)	<i>Tamarindus indica</i>
104	Eenthapanakkai	<i>Cycas circinalis</i>
D. Dye and Paint Items		
105	Kannadivella	<i>Vateria indica</i>
106	Kundirikkam/Thelly/Kumgilliam/ Pamdarn/Pachavettu (I Gr)	<i>Canarium strictum</i>
107	Kundirikkam/Thelly/Kumgilliam/ Pamdarn/Pachavettu (II Gr)	<i>Canarium strictum</i>
108	Kundirikkam/Thelly/Kumgilliam/ Pamdarn/Pachavettu (III Gr)	<i>Canarium strictum</i>
109	Seethari	<i>Ipomoea paniculata</i>
110	Pathiripoovu/Ponnampooovu/Pasupasi	<i>Stereospermum colais</i>
111	Dhobikkai/Thembramkkai	<i>Semecarpus anacardium</i>
112	Koppuvella	<i>Vateria indica</i>
E. Soap and Shampoo Items		
113	Cheevakkai/Cheenikkai/Puinjikkai	<i>Acacia concinna</i>
114	Pattinja	<i>Acacia intsia</i>
115	Soapnuts/Uruvanji/Savakkai	<i>Sapindus trifoliatus</i>

(Contd)

Appendix-I (Contd)

SI No	Malayalam Name	Scientific Name
F. Miscellaneous		
116	Kolinja	<i>Acacia intsia</i>
117	Panjikkai	<i>Bombax ceiba</i>
118	Dharbapullu	<i>Imperata cylindrica</i>
119	Eramkol (I Gr)	<i>Oxytenanthera monostigma</i>
120	Eramkol (II Gr)	<i>Oxytenanthera monostigma</i>

Source The Kerala State Federation of SC/ST Development Co-operative, Thiruvananthapuram, 1993

- Note 1) Classification of the above items has been made by discussions with the experts in the field, namely Ayurvedic physicians, Branch Managers of SC/ST Federation and the wholesale traders of the above produce
- ii) So far no collection has been made for marottienna (liquid)
- iii) Of the 31 TCS, only two TCS were engaged in Erankol collection, that too in limited number, therefore it was eliminated from the preparation of this Paper

Financial Institutional Interventions for the Promotion of Non-wood Forest Produces (NWFPs) in India

M.P. Jahagirdar

India is blessed with all types of vegetation like tropical, sub-tropical, temperate and alpine. Looking at its wide ranging environment and diverse biological communities, India has been identified as one of the top twelve 'mega diversity' nations of the world.

Out of nearly 21,000 species available in Indian forests, about 3000 species, yield the Non-wood Forest Products (NWFPs). Various studies (ASCI 1978, Gupta and Guleria, 1982, IBARD, 1991, CSE, 1985; Prasad and Jahagirdar, 1993) have revealed that most of the people living in and around forests depend on these products to an extent of 20 to 90 per cent, for various economic activities and subsistence living.

The royalty realised through the disposal of NWFPs, collected and extracted from the state forest departments was over Rs 1000 million during 1985-86, which has increased in the subsequent years. The contribution of NWFPs to the total value of forest based export is over 70 per cent and the available potential is still enormous.

In employment generation field, out of the total employment of 2.3 million man years generated from forestry sector, 1.6 million man years is available from NWFPs and there is a vast potential to increase this to about 4 million man years (Gupta and Guleria, 1981).

Looking at the importance of NWFPs role in the local people's livelihood, domestic and international market, the government has realised its worth and initiated various activities. The National Forest Policy, 1988 also suggests that the NWFPs, which provide livelihood and employment to the people living in and around the forests should be protected, improved and their production be increased.

In this context, while enough attention is being given to the management and administration of NWFPs, the efforts for their production and development are lacking. Some of the problems in this respect are: i) the present status and potential of many NWFPs have not been fully identified and understood, ii) the value-addition part of the NWFPs have not attracted the attention of development planners because of lack of infrastructural facilities, and iii) the lack of

institutional support, especially from the credit institutions, in order to facilitate the activities related to cultivation, production and value-addition of NWFPs

With the introduction of Joint Forest Management (JFM) approach for the protection, development of the forest as well as the people, the whole concept of development has changed. This has also resulted in identifying the new areas and methods of development. One such area identified is the NWFPs, which has tremendous development potential. This paper highlights available facilities and systems of the financial institutions¹, especially the rural bank branches, and scope of integrating them into the NWFPs development.

The paper is presented in four parts. The first part deals with institutional arrangement for micro-level planning process. This is with special reference to the credit institutions, i.e., bank branches. The second part deals with the functions and philosophy of JFM. The third part deals with the integration process of village credit plans of the banks and people's working plans of JFM. Last and the fourth part deals with the priority sector lending and refinancing facilities available for the NWFP based schemes.

INSTITUTIONAL ARRANGEMENTS FOR MICRO-LEVEL PLANNING

In order to help the development of a specific area, each rural bank branch is being allotted to a few selected villages. This is to enable the branch to concentrate on its productive lending activities, keeping the potentialities of the area and needs of the villages in view.

This is known as 'Service Area Approach' which involves four major aspects:

- i) identification and allocation for each branch a certain number of villages,
- ii) surveying the villages (allotted) for assessing the potential for lending activities,
- iii) preparation of village credit plans (VCPs) on an annual basis for the development of allotted villages, and
- iv) co-ordination and monitoring on an ongoing basis.

Identification and Allocation of Villages

Specific areas are being identified and allocated to each rural bank's branches. Each branch is having, on an average, 15 to 25 villages (in forest areas, the no. of villages allotted will be less) as its area of operation. The cluster

¹ The financial institutions referred here are Commercial Bank's rural branches and Regional Rural Bank branches.

approach is generally followed in selecting the villages keeping their contiguity and proximity to branch

Survey of Villages

Once the villages are allotted, each branch has to undertake a survey of all the villages and prepare village profiles. These surveys should cover different aspects like existing economic activities and potentialities for their expansion as also for undertaking new and innovative activities; available infrastructure in the area, skills available with the villages and the number of beneficiaries to be provided with credit facilities

The data available with other departments and agencies like Industry, DRDA, DIC, etc, will be made available with the co-ordination of Lead Bank Officer (LBO) of the concerned district. The District Development Managers (DDMs) of NABARD will also be available at the district head quarters to facilitate and identify different schemes from the point of getting refinance facility

Preparation of VCPs

Irrespective of the type of area of operation like plain, forest, desert, all the banks will be preparing the annual credit plans for all the villages under their service area. These plans reflect the needs and potentialities of the area, based on the data collected through individual villages/villagers and other concerned agencies

It is here, that the banks and the concerned departments like forests and industry can come together and keeping in view of the potentials, the annual credit plan has to be formulated. May be, it is the lack of awareness of the availability of such mechanisms and co-ordination, as the things are not happening in the desired way

The major steps involved in preparation of the VCPs are

- i) confirming to the Technical Feasibility of the Activity,
- ii) establishing the Economic Viability of the Activity,
- iii) estimating the Potential Number of Technically Feasible and Economically Viable Units, and
- iv) estimating the Number of Units which would require credit and the quantum of credit available from the bank

Identifying technically feasible activity requires knowledge about the relationship between the resources (raw materials) and resultant production possibilities (final products). This being technical, naturally falls within the purview of forest department. For example, from which medicinal plant what medicine is to be prepared, the quality of the new material, the availability of the

machines, seasonal demands and storage facilities, etc , are to be taken care of

All the technically feasible activities need not be economically viable. Verifying the economic viability is the task of credit institutions. With the help of data like, necessary inputs and their costs and possible outputs and their prices, the viability is calculated. The data for this exercise has to be provided by the forest department and the data should be realistic with local relevance and applicability.

Having ascertained the feasibility and viability, it is essential to work out the number of units which can be sustained in the operational area of the bank. Depending on the 'critical constraining factors' the credit plan preparation should be a joint exercise of bank, forest department and other concerned departments like Industries and Welfare, etc

It is necessary that the draft credit plan should be discussed in the Block Level Bankers Committee (BLBC) before its finalization

Coordination and Monitoring

The BLBC is formed to co-ordinate the activities of the bank and different government departments like Agriculture, Industries and Animal Husbandry, etc. The LBO of the concerned district is the Chairman of the BLBC. This BLBC is expected to meet once in a quarter to take stock of the progress.

The representative officials of the forest department at the block level, who are usually the Rangers, are not being included in the BLBC. It is perhaps because, the administrative boundaries of the block does not coincide with the boundaries of forest divisions or ranges. Also there is no official of the department, representing at the block level. The other reason in majority of the areas is the potentialities of forests and forest based programmes which may be very few and routine in nature, hence representation of forest official on BLBC has not been visualised. But at the same time, in the BLBC guidelines, it is mentioned specifically that any official concerned with the development of the block, as and when required, may be invited for the BLBC meetings.

JOINT FOREST MANAGEMENT : FUNCTIONS AND PHILOSOPHY

The concept of Joint Forest Management (JFM) is the outcome of realisation that without willing and active participation of the people living in and around forests, no programme to protect and regenerate the degraded forests is possible. It is the virtual exclusion of these people, who are depending on forests since centuries, from the programmes related to forest that has led to the collapse of the traditional collective management system and to the present crisis. The JFM is based on the philosophy that the people protect forest lands and help in their regeneration in lieu of right of collection of dead wood and NWFPs and a share in the timber.

Today most of the foresters will not hesitate to adopt the JFM approach if forests were to survive. But this 'Joint Management' can succeed only when the well planned packages and benefits are offered through attractive schemes and appealing financial and credit facilities. With its limited budgetary allocations, the forest department alone can not meet the demands. This necessitates the need for co-ordination and collaboration with other agencies which can support the forestry and forest based activities through wage employment, regeneration, production, processing and manufacturing. To fulfil this need, the Commercial and the Rural banks are the most appropriate institutions available right at the field level to provide support to the same cause for which the forest department is thriving.

The broad objective of the JFM is to involve the people in the management of national forests and link the people to the benefits accruing from forests, including NWFPs, and their proper management. Since, the unit of JFM is a village and its surrounding forests, it implies that a working plan, which is designated here as 'People's Working Plan (PWP)' should be attempted to link the area's resources, people and the potentialities.

Preparation of PWP under JFM through Village Forest Committee (VFC) calls for a survey of the area, the resources and potentials available. A topographical map or the satellite imageries of the forest block can be made use of and people can identify the area of use and preferences for the utilisation of resources.

In due course of time, it is not the management nor the rights in forests, which attract the people, but the employment and production activities providing a better income on a continuous and sustainable basis.

INTEGRATION OF VCP AND PWPs

The PWP envisaged under the JFM and the VCP being prepared by the bank branches under the service area approach are almost similar in objectives and characteristics. With the identification and recognition of the potentials of NWFPs, the time is ripe for the bankers and the forest department to come closer and work together.

In each village, under JFM approach there will be a VFC representing various sections including women, who are selected by consensus. The PWP envisaged under the JFM is a joint exercise between the local community and the forest department keeping in view the needs of the people as well as the capacity and potentials of the area. The VCPs prepared by the bank branches are also based on the same philosophy. It calls for all the three concerned, the people, the banks and the forest department to come together for preparation of common PWP.

The preparation of PWP, on an annual basis, will be consisting of two components – forest based and non-forest based. In the forest based component, wood and non-wood based activities can be identified separately. The wood based activities and all other activities of general and infrastructural nature will form part of the working plan of the forest range, whereas, the specific activities of NWFPs and the same of the non-forest based, where the credit is involved will become the credit plan. Component wise of this exercise is shown in Fig. 1.

In the non-credit component, the people have to identify the required infrastructural facilities of both general and specific type and social and cultural activities envisaged by the village community.

In identifying the activities and potentialities, the people's participation is a crucial parameter. While JFM is a concept through which people's participation is visualised, the PWP would be the operational tool.

PRIORITY SECTOR LENDING AND REFINANCING

With the introduction of social control in 1967 and subsequently, the nationalisation of major commercial banks in July 1969, the banks have started playing a substantive role in providing credit facilities to the rural poor. In due course, it was found that the coverage of rural lending was not satisfactory in certain sectors of economy, and the banks were further mandated to achieve the set targets through lending known as 'priority sector lending'. As per this, forty per cent of the total credit is required to be channeled to the identified priority sectors such as agriculture, small scale industries, small business and allied activities. Though forestry has not been specifically mentioned, all activities relating to NWFPs development like cultivation, processing, manufacturing, storage, transport and other value-addition activities can be considered under priority sector lending.

Recently, the Ministry of Environment has also introduced a scheme for 'minor forest produce' under its wasteland development programme. This scheme envisages plantation of fruit trees, Bamboo, Cane, Tendu, Harra, etc., and also Lemon grass and medicinal plants. The major activities under the scheme are:

- i) raising plantation of Bamboos with fruit bearing species like Harra, Imlī, Mahua, Chironji, Aam, Kathal, Bhilwana, etc., and oilseeds bearing trees,
- ii) raising plantation of tendu leaves under a light canopy of trees,
- iii) plantation of cane,
- iv) cultivation of medicinal plants, and
- v) cultivation of rosha grass/lemon grass.

The National Bank for Agriculture and Rural Development (NABARD) has issued circulars and decided to liberalise its existing policy by extending

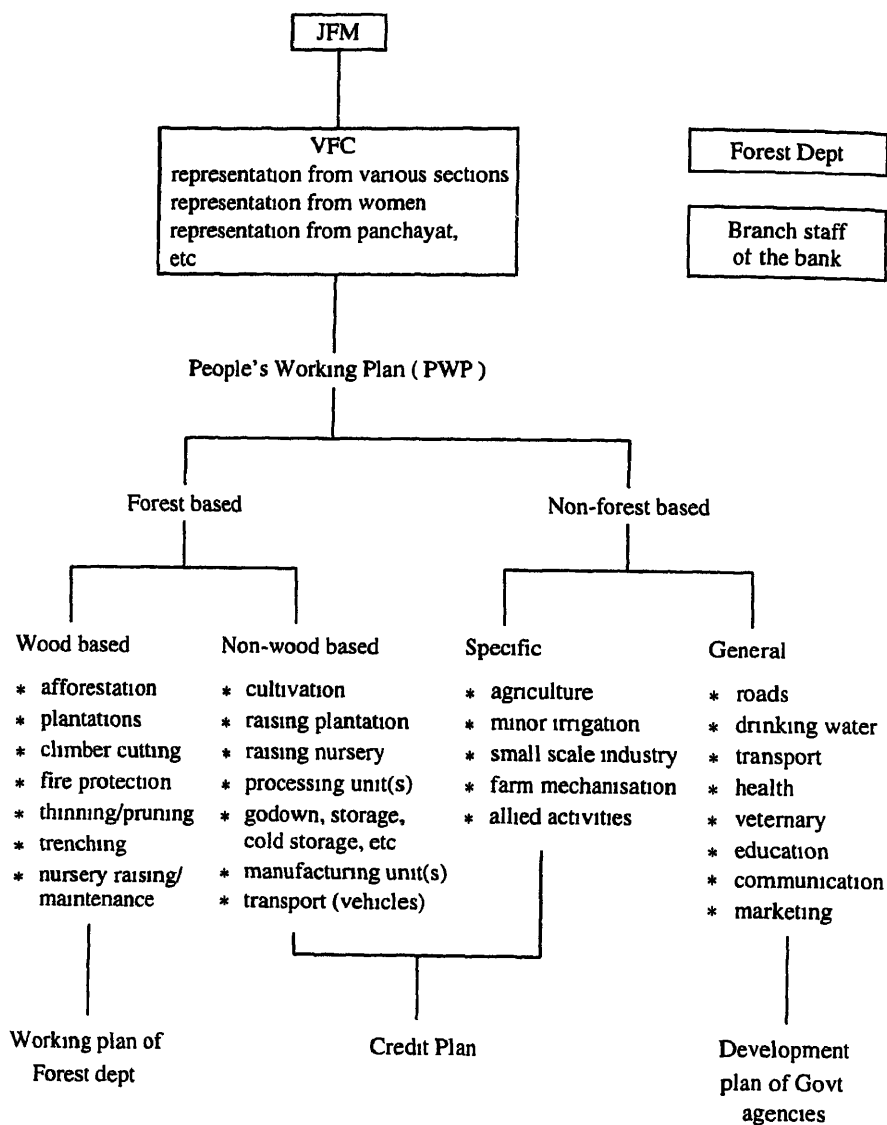


Fig. 1: Integration of village credit plan (VCP) and people's working plan (PWP)

refinance support to all bankable Forestry Development Programmes on the wastelands. Similar policy decision should also be taken for all NWFP activities and the refinance facility should be provided to the commercial banks and RRB's.

Pending such guidelines, from NABARD and RBI, should not become an obstacle for the bankers to extend the credit facilities to the NWFP activities. As

long as the activities are technically feasible and economically viable and people are willing to undertake the schemes, the credit can be extended under the allied activities of the 'priority sector lending'. It only requires innovative ideas based on the potentials to exploit the situation.

CONCLUSION

India being a mega-diversity nation with more than 3000 species yielding NWFPs. The revenue returns and employment generation from these NWFPs seem to be enormous and most of the potential has not yet been tapped properly. The people living in and around the forests depend on it for a variety of activities including subsistence living. The recent National Forest Policy also suggests that the NWFPs, which provide livelihood and employment should be protected, improved and developed. In this direction, one of the major factor, identified for the development of NWFPs and the people depending on it, is credit.

India is having one of the best networks of Commercial and Regional Rural Bank branches in the rural areas. These rural branches are also mandated for specific sector lending and percentage of lending. The banking system has also evolved a strategy and system for the development of rural and tribal areas like preparation of Village Credit Plans and Service Area Approach, etc., where planning has to be done keeping in view the potentials, of the area and the resource available, etc.

The forest departments have also launched a concept known as JFM where emphasis is being given for not only the protection and conservation of forest but also for the development of its inhabitants. The strategies proposed under JFM are in tune with the strategies of banks as far as the micro-level planning of the credit and non-credit inputs are concerned. Hence, integration approach of both forest department and credit institutions can become one of the best things to happen in the development of NWFPs.

There are also provisions available for the refinancing of the lending done under the forestry and NWFPs sectors.

Section 9

**NTEP IN JFM AND PARTICIPATORY
COMMUNITY FOREST
MANAGEMENT INCLUDING
ROLE OF WOMEN**

Role of Non-timber Forest Products in Joint Forest Management

O.N. Kaul and Ratna Srivastava

INTRODUCTION

A large section of India's rural and urban poor, have a subsistence dependence on the forests for food, fuel, fodder, shelter and income. Even where the livelihood patterns of forest communities are gradually undergoing a change and their degree of subsistence dependence is declining, it has been necessitated owing to degradation of forests and depletion of resources. Meagre and fluctuating income from agricultural pursuits makes their plight worse. Non-timber forest products (NTFPs) can be an important source of cash. The income generating potential of NTFPs is not only enormous, but can also be channelized on a sustained basis. Thus NTFPs can offer a continuous flow of benefits to societies, traditionally dependent on forests for their survival as well as livelihood.

The forests in the Shivalik region of Haryana are located mostly in a hilly undulating terrain. These forests covering the watershed are crucial for the maintenance of ecological stability of the region. Years of exploitation of the once densely forested areas, have rendered the region barren, making it susceptible to extensive soil erosion. Restoring such degraded natural forests is a daunting task. The Joint Forest Management (JFM) Programme has endeavoured to do so, through a reciprocally benefitting arrangement, ensuring protection and rehabilitation of the forests by the local communities in return of access to various forest resources — grasses, bamboo, etc. Access to NTFPs has been a major anchor of the JFM programme in Haryana.

THE REGION

The Shivalik region extends along the northern border of Haryana as a belt of hills 5-15 km in width and 100 km in length from the south-east to the north-west, parallel to the outer Himalayas. The elevation varies from 500 m to 1000 m and approximately 680 km² of forest land falls in Haryana Shivaliks.

The region has a weak geological character of sandstone, grits, conglomerates, clays and silts, with fluvial deposits of torrential streams. The soils are mostly sandy, however, loam and clay mixed soils are also found. Though the

moisture retention capacity is good, excessive run off leaves the soils dry

The vegetation is of tropical dry deciduous mixed type. The well-wooded forests of the past, now support a sparse and stunted cover consisting of *Acacia catechu* (Khair), *Acacia leucophloea* (Reru), *Anogeissus latifolia* (Chaal) as the common tree species, with shrubs of *Dodonea viscosa* (mehander), *Adhatoda vasica* (Basuti), *Carissa spinarum* (Karaunda) and now, *Lantana camara*. The area also has grass species of *Chrysopogon fulvus* (Dholu), *Heteropogon contortus* (seriala), *Eulaliopsis binata* (Bhabbar) and *Dendrocalamus strictus* (Baans).

Traditionally a three-tier system of forest land has been followed, ever since the land settlement was done before independence. The rights and concessions allowed to forest dwellers varied. The Reserve Forests were generally free of all rights by public. In the Demarcated Protected (DP) forests, certain rights of public to forest produce were permitted and in the *dehati* of village forests, grazing, cutting of trees for fuel-wood, etc. were allowed.

FOREST RESOURCE – COMMUNITY ALLIANCE

The Shivalik region of Haryana has a characteristically heterogeneous social structure. The various social groups inhabiting this region exhibit not only caste and religious variations, but a diversity of forest resource dependence and use patterns also exists. Often such different patterns are mutually incompatible, a situation leading to conflicts over resource utilisation. Of the nearly 17 different social groups, there are broadly three categories of users, on the basis of their dependence on forest resources.

The communities having a **primary dependence** on forest resources for their livelihood, include two sub-categories: those directly utilising the forest produce and those processing it. The first sub-category consists of the grazier communities, mostly *Gujjars*, dependent on the forest grasses for their livelihood. They have since generations been itinerant herdsmen, raising livestock and practising open grazing. The nature of their forest dependence has often been antagonistic to the efforts aimed at protecting regeneration and developing soil cover. The other sub-category of the forest produce processors comprises two occupational groups of the *Bhanydas* and *Banjaras*. *Bhanydas* weave bamboo baskets and *Banjaras* weave rope from *bhabbar* grass, for their living. The economic dependence of these forest dwellers is not necessarily contrary to the objectives of forest protection and management. However, conflicts over rules governing access to produce and the tendency to over-exploit the resources have existed. Nevertheless, these communities have traditionally the maximum stake in the status of forests, for no other reason than their almost complete dependence on the produce.

The second category is of groups exhibiting a **partial dependence** on forests

for supplemental source of fodder. These communities (mostly *Jats* and *Gujjars*) pursue dairying as an occupation. Most of the nutritional requirements for their stall-fed buffaloes are met from agriculture and/or commercially available fodder/cattle feed. However during winters, green fodder grasses from the forests are collected. Depending upon the economic status their reliance on forest-based fodder varies. Besides fodder, some of their domestic needs of fuel-wood, small timber, etc., are also met from the forests.

The third category is of communities having a **subsistence dependence** on forests. This includes groups who depend on forests for meeting their subsistence needs. For livelihood they have other means, but totally depend on forests for fodder, fire-wood, small timber, etc.

JFM POLICY AND THRUST ON NTFP

The thrust of NTFPs in JFM, has its origin in the National Forest Policy Resolution of 1988, where one of the basic objectives stated is to meet the requirement of fuel-wood, fodder, minor forest produce (MFP) and small timber of the rural and tribal populations. The policy states, as one of the essentials of forest management, that MFP provides sustenance to tribal population and to other communities residing in and around forests. Such produce should be protected, improved and their production enhanced with due regard to generation of employment and income. It also states that provision of sufficient fodder, fuel and pasture, specially in areas of adjoining forest, is necessary in order to prevent depletion of forest beyond the sustainable limit.

The Government of Haryana (GOH) adopted a resolution on June 13, 1990 for furthering people's active role in the management of depleting forest resources. The basic philosophy underlying the JFM policy in Haryana is to link the economic interests of villagers living adjacent to forest areas with sustainable management of these areas. This would be achieved through identifying one or more **catalysts** in each village which would motivate the villagers to improve the productivity of the forest areas, and giving them a major share in the increased production. The policy envisaged that if the productivity of the forest belt adjacent to villages is sufficiently increased through joint management to meet all the villagers' requirements of biomass products, the productivity of the forest areas beyond this belt will increase through natural regeneration, thereby increasing the government revenue from these areas without much additional investment.

The **catalysts** identified in Haryana have been akin to **incentives**, motivating the people to protect the nearby forests and adopt practices congenial to their regeneration. The JFM program in Haryana has depended extensively on the **locally utilisable NTFPs**, apart from relying on the water-harvesting strategy. The most commonly found NTFPs in the Shivalik belt in Haryana are the fodder

grasses, the fibre grass, and bamboo. These products have been utilised by the inhabitants over the years, for not only domestic purposes, but they also enjoy a market value in the processed/unprocessed form.

Prior to JFM, the people had been collecting forest products from forest areas, where they had enjoyed traditional rights. But with the degraded sites and increasing demand and biotic pressures, such areas could barely satisfy all the requirements. Hence, infringements on to prohibited areas often occurred, with forest biomass not only being removed illicitly, but often beyond the sustainable quanta. Such situations created conflicts between the people and forest department, adding further to the existing mistrust and 'policing' tendencies. However, provision of NTFP – **harvesting rights at concessional rates** to the local communities within the JFM framework, has been a watershed. It has precipitated collective action for protection and management of forests. This has helped in community-based institutions taking root, [Hill Resource Management Societies – (HRMS) – village-level, registered bodies with community membership], with benefits accruing to the people at large, both in monetary and non-monetary terms. The task of the forest department too has become easier in the sense of vigil and patrol required over the areas.

NTFP AS AN INCENTIVE IN JFM

Fodder Grass

Fodder needs of the local inhabitants are high in this region, specially during the lean seasons. Apart from the *Gujjars* who have traditionally reared livestock (mostly goats and cows), the other communities too have a high fodder dependence on the forest areas. The commonly preferred fodder grass species in this region are *Chrysopogon fulvus* (*Dholu*), *Cynodon dactylon* (*Doobda/Khabal*), *Heteropogon contortus* (*Seriala*) and *Saccharum munja* (*Sarkada/Thooudh*).

The earlier practice of Haryana Forest Department (HFD) was to auction forest areas for fodder grass on an annual basis to contractors. The local villagers could only buy the grass from contractors by paying *Dati*, an amount fixed by the contractor, for cutting fodder grass, every season. The *Dati* levied on the villagers was very high, ranging from Rs 650-1200, for collecting a grass headload from November to June.

It was in 1983, that for the first time HFD leased out fodder producing areas, directly to the village HRMS, at the average price of the previous three years' auction. The society in turn levied *Dati* at concessional rates, making fodder grass easily available to the villagers at a rate of about Rs 150/- This practice soon spread and leases are now given to many other societies.

Fibre Grass

Other than fodder grasses, the region is rich in *Eulaliopsis binata*, commonly

known as *Bhabbar/Sabai*. Owing to its fibrous nature, this grass has a tremendous market value both in the unprocessed and processed forms. The grass is utilised locally for making *baan* or ropes. Rope making forms the mainstay of the economy of the *Banjara* community, the traditional rope makers. Fibre grass rope (*baan*) is primarily used in stringing traditional beds (*charpois*) and for tying agricultural produce, livestock, etc. In the states of Bihar, Uttar Pradesh, Madhya Pradesh, Haryana, Punjab, Rajasthan and Gujarat, crude estimates indicate that there may be 200 million such *Charpois*. Every two to three years, these beds are restrung, requiring 4 kg of rope. This creates an annual demand of nearly 250, 000 to 4000, 000 metric tonnes of rope. In addition to this, nearly 100, 000 metric tonnes of *baan* are needed for tying purpose (Poffenberger and Sarin). Apart from this usage, *bhabbar* has great commercial importance as raw material for paper manufacture.

Prior to JFM, the HFD used to lease out *bhabbar* producing areas to paper mills. This practice was nearly 4 to 5 decades old and long-term leases were granted at nominal rates of Rs. 2.8 per tonne till 1980, when the leases expired. This was followed by open auction, with prices increasing to Rs. 180 to Rs. 289 per tonne (Poffenberger and Sarin). In 1989 fresh leases were again granted. However keeping in line with the JFM concept, the HFD in 1986 started leasing out *bhabbar* areas to the villagers, through the HFMS, the price being the average of previous three years' auction. This marked a significant step in the transfer of management responsibility to the community. It has proved beneficial to the *Banjara* community, the womenfolk in particular. Easy access to an important livelihood resource has been assured, and that too at relatively concessional rates.

Bamboo

The third important NTFP that has played a vital role in Haryana JFM, has been bamboo. Bamboo again is a livelihood resource for the *Bhanyda* who weave baskets. These communities have enjoyed bamboo harvesting rights in the adjacent forests since 1943, when the government of Patiala allowed them to take 100 bamboos per month per household at the rate of Rs. 3.12 for a six month period (October-March). Later, in 1973 the GOH specified rules and conditions for *Bhanydas* for obtaining bamboos. They were allowed 100 bamboos per household per month for 6 months at Rs. 15. The rates were however, increased to Rs. 30 per 100 bamboos in 1979, and later, the number lowered to only 50 bamboos.

With the JFM programme, the *Bhanydas* communities residing at Kalka and Bargodam areas, have been allowed access to 100 bamboos per month, for a 9-month period (October-June), at a concessional price of Rs. 7/- only.

Compared to the earlier status, this implies a three-fold increase in the annual supply of bamboos to the *Bhanjdas*.

GRASS YIELD CHANGES AND MANAGEMENT IMPLICATIONS

Voluntary community protection has contributed towards regeneration. Studies of impact of different periods of protection show changes in the yield pattern and cover of grasses. The yield increase is maximum with three years of community protection (3 times for *bhabbar* and 9 times for fodder grasses, as compared to the unprotected patches). An interesting aspect is that yield of *bhabbar* increased to 233.3% and 257.6% in the third and sixth year of protection, but continued protection did not elicit an increase. Instead significant drop was observed by the tenth year. The yield trend for fodder grasses is similar, with only the increase in the first three years being sharper and the decline setting in soon after. The yield pattern is depicted in Figure 1.

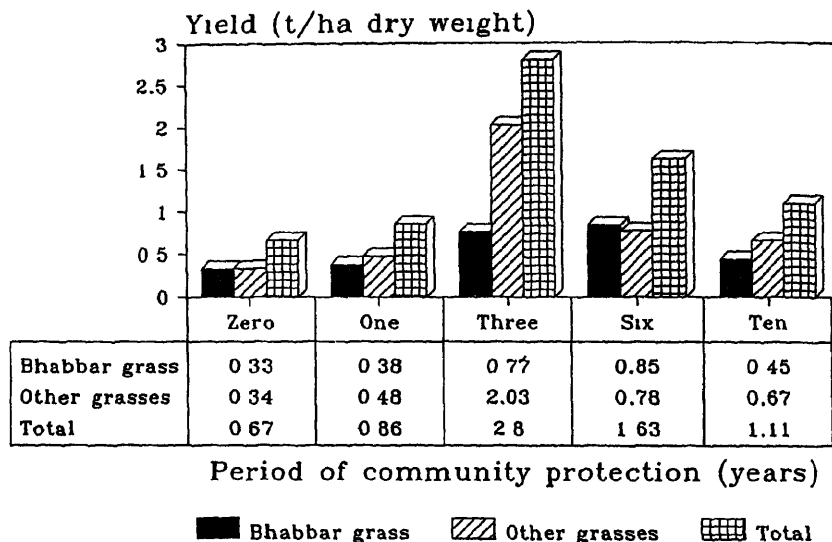


Fig.1: Average yield (t/ha) of *bhabbar* and other grasses under community protection

Source: Panda *et al*, 1992

Another study revealed a 7-fold increase in number of clumps and 6% increase in cover of *bhabbar* with three years of protection. The clump size increased from 22 cm² with one year protection to 56 cm² and then 75 cm² with three and six years of protection. A decrease to 57 cm² in clump size occurred in ten years. The pattern of fodder grasses was similar except that they respond to protection earlier than *bhabbar* (basal cover of fodder grasses increased from

3.55% in unprotected areas to 5.34% in one year of protection, while *bhabbar* cover remained nearly same (1.46% to 1.43%) in one year of protection)

The growth behaviour of grasses, especially *bhabbar*, has major implications on the management strategy to be adopted in a JFM programme dependent on such NTFPs. Continued protection only retards the growth and regeneration of grasses owing to the overhead shade cast by the increased tree canopy, as the regeneration of trees and their growth receives a boost with protection. Plenty of sunshine is essential for abundant yield of grasses. Moreover, the grass clumps of *bhabbar* arising from seed are more vigorous and the clumps exhibit an ageing phenomenon- the clump gets old and degenerates after an optimum size, splitting into less vigorous clumps. Thus number of clumps/hectare may increase but clump size declines and the yield declines with such less vigorous clumps. Thus it becomes important to adopt wider spacing for trees than usually practised (10m x 10m instead of 3 x 3 m or 4 x 2 m, etc.), promote tree species with lighter crowns (as *Acacia* spp., amla, semal, etc.) and periodically plant slips of *bhabbar*. These options become essential to sustain a programme based on NTFPs. Hence, the singular emphasis on timber production, as in the traditional forest management practice has to be reviewed in light of NTFPs, and an approach towards multipurpose forestry has to be evolved.

GRASS LEASES AND SOCIO-ECONOMIC BENEFITS

Comparative studies of *bhabbar* areas managed by the people's HRMS and paper mills reveal certain facts. The total yield, and yield per hectare for both *bhabbar* and other grasses is higher (combined yield is almost twice) in the areas managed by the HRMS than in those leased out to the mills. The reasons are two-fold. Firstly, areas leased to the HRMS yield more grasses because of better protection and management practices adopted by the villagers. Naturally, their interest in protection is enhanced when a directive incentive is available and grazing thus gets prohibited. Secondly, the total potential of area gets tapped when HRMS is the lessee and complete extraction is ensured. Whereas, areas leased to paper mill remain under-harvested, because the mill gets lease on a per quintal rate, based on old under-estimated records, and once their target is achieved, the interest of paper mills to harvest the entire grass dwindles, as it is uneconomical in a difficult terrain.

Providing grass lease to HRMS has been favourable to both the HFD and people as described earlier, because of under-harvesting of areas leased to paper mill, the revenue realised by HFD is less. In case of grass leases to HRMS, (even at concessional rates), the loss in revenue due to under-harvesting is avoided. The villagers on the other hand, not only get the fodder grasses at a much cheaper rate, but they also get substantial amount of revenue by selling the *bhabbar* to a contractor at higher rates, due to increased production.

Moreover, elimination of contractors at the initial level, and the sale of grass by HRMS at later stages, has led to generation of additional income. This money which the contractor would have otherwise earned was now available for development activities in the village. There are societies that have used this fund for activities like desilting the common village pond, for brick lining of the village streets, building and repair work of schools, providing drinking water facility for their cattle.

Apart from monetary outflows, the grass leases, in particular the fodder grass availability has brought about changes in social practices. Social fencing got a boost and stall feeding has been taken up. Availability of green fodder grasses after rains, has encouraged buffalo rearing in lieu of goats and nearly 75% of fodder needs (September to March) was met from harvested forest grass.

Different (six) management systems for *bhabbar* lease exist (where the lessee can be either HRMS or the local contractors or paper mill). Study of economics, from the flow of *bhabbar* to the final consumers, reveal certain facts. The 6 different systems are

- I. *Bhabbar* leased directly to HRMS, and
 - a) HRMS further sublets it to one of its members,
 - b) HRMS harvests *bhabbar*, converts it to rope and sells it,
 - c) HRMS employs labour to harvest *bhabbar*, giving the labourers half of *bhabbar* in lieu of wages, and
 - d) HRMS manages the leased area on its own
- II *Bhabbar* leased to paper mill, which further sublets it to a contractor for harvesting.
- III *Bhabbar* leased directly to a local contractor in an open auction

The comparative analysis of profit of these six systems is shown in Figure 2

Thus profit per quintal of *bhabbar* accruing to the HRMS is more when they manage it on their own and maximum profit is earned by the HRMS when they do some secondary processing and sell the value-added product (rope). Secondary processing (rope) provides for additional employment to the villagers, and a better selling price for the product. Even when secondary processing is not done, but *bhabbar* is managed by HRMS, they earn good profit. In case of sub-contracting *bhabbar* by HRMS to a member contractor, a major portion of its profit gets lost. Thus for *Banjara* community the most attractive proposition is to let their society take the area on lease, harvest it and returns can be more if ropes can be made by machine than by hand. Mechanised rope-making can be considered, if a continuous supply of *bhabbar*, in bulk is possible. Moreover, *banjara* women prefer making ropes by hand.

BAMBOO PERMITS AND BENEFITS TO COMMUNITIES

The bamboo permits are issued by HFD to the *Bhanjda* residents at three

System

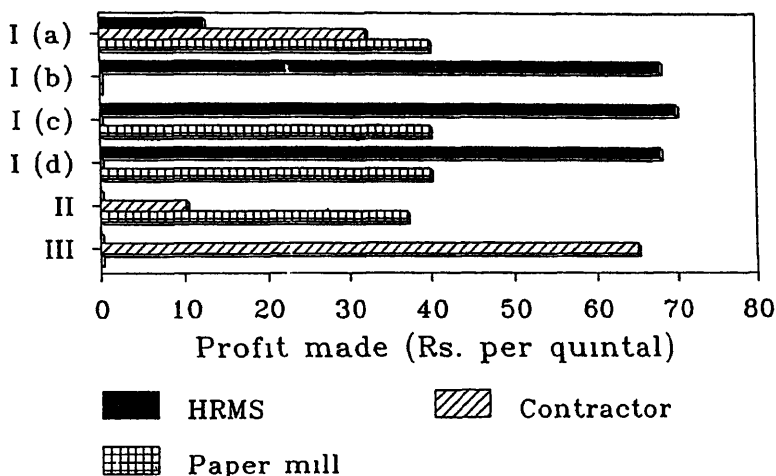


Fig. 2: Comparative analysis of various *bhabbar* management systems

Source Vara *et al.*, 1993

settlements, namely Bargodam, Bowana and Kalka. The baskets are in good demand among the fruit and vegetable vendors and poultry farm owners, however the demand is highly seasonal. With green bamboos being required and available from October to June only, this employment is available in these 9 months only. The *Bhanydas* rely more on middlemen for marketing of baskets, who make more profit. The market price is almost double the sale price realised by *Bhanydas*, thus they suffer a loss of 38% to 9% depending on the basket size. Elimination of middlemen remains a necessary task. The *Bhanydas* also realise the loss in earnings when produce gets sold at lower prices. The one-time increase in their income occurred between 1989-90 and 1990-91. It was in 1990-91 that they got 100 bamboos at Rs 7 for nine months (instead of 100 bamboos at Rs 30 for 6 months). Their earnings had then registered an average monthly increase of 7.7% and about 61% yearly increase. Avenues for providing support to *Bhanydas* to develop a marketing system, need to be explored such as, some governmental or other agency involved in marketing rural handicrafts.

CONCLUSION

Understanding the interests and dependence of local communities on NTFPs and giving this aspect due recognition in the mechanisms/strategies evolved for implementation of the JFM programme in Haryana, has brought about

ecological restoration along with economic betterment. Thus, linkage between socio-economic development and ecological concerns has been made possible. NTFP like *bhabbar*, fodder grass and bamboo have acted as anchors to the programme. The contribution of NTFPs to the rural economy is immense. The returns for NTFPs are not only high but are quick in nature. This factor gives the NTFP oriented JFM programme in Haryana an edge, where the urge and effort put in by the people in protecting the forest, are rewarded in not too distant a future. As an evolving and long-drawn programme that JFM is, its sustainability needs to be ensured and strengthened. In this perspective NTFP based activities can play a crucial role. Infrastructural, institutional and purely scientific forestry measures for promoting NTFPs under JFM, thus need to be evolved.

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NTFPs in Joint Forest Management

S. Palit

INTRODUCTION

Non-timber forest products (NTFPs) and non-wood forest products (NWFPs) are terms that are being widely used currently to denote what was termed minor forest produce earlier. The term NTFP as is used now broadly includes, fuel and fodder, biomass, bamboo, cane, grasses, fibre, oil, tannin, dyes, gums, resins, medicinal plants, barks, leaves, flowers, fruits, tubers, mushrooms, seeds, mammals, birds, reptiles, fish and insects (Tewari, 1993).

The term minor forest produce (MFP) is a misnomer indicating that the produce was not of any great economic importance to merit serious consideration. However, recent facts and figures give altogether a different picture. NTFPs accounted for nearly two fifths of forest department revenue and three fourths of net export earnings from forest produce (Commander, 1986).

About 70% of the NTFPs are collected from the five states of Maharashtra, Madhya Pradesh, Bihar, Orissa and Andhra Pradesh (World Bank, 1991). Sixty five per cent of India's tribal population live in these five states.

It is estimated that employment opportunities through collection of NTFPs can be increased from 0.8 million person years to 3.3 million person years (LBSNAA, 1994). Again, it is estimated that out of approximately 571.85 woman days of women's employment generated in forest-based enterprises, 90% is in small scale enterprise using NTFPs as raw material (Khare, 1987).

It is worth recalling here that the figures for NTFPs have been derived from forests which are already degraded. With the improvement of the protection status of the forests through JFM, it is expected that barring a few items like bidi leaves, production of most other items will increase significantly and the total turn over in terms of money will far exceed timber. Consequently, both the employment potential as well as the export earnings will also go up. Despite all this, adequate attention has not been paid to NTFPs either at the national or at the state level. The Forest Research Institute, Dehra Dun, which was set up earlier to provide research support to forestry primarily concerned itself with timber. In a bid to respond to the regional needs, regional research institutes have been set up recently. NTFPs, barring a few, are so area specific that even such regional institutes will not be able to fully address the problems. NTFPs

should, therefore, form an integral part of state research with linkages established with the regional institutes

JOINT FOREST MANAGEMENT

It is now accepted that the traditional management technique depending on custodial policing has failed to protect the forests. It has also been established that it is only through a collaborative effort with the people that the forests can be conserved and developed (Palit, 1993). Because of this realization, Joint forest management has been adopted by as many as fourteen states in the country. The fourteen states which have passed JFM resolutions account for nearly 72% of the country's forests (Sarin, 1994). The need of the hour is to see that the new form of management which provides the country with virtually the last chance to save its forests is sustained.

To make the new management system work we have to look into a number of institutional aspects like research and training, development of suitable infrastructure, relationship with the panchayats, gender issues, opportunity costs, availability of funds, community development, etc.

The system has to be both ecologically sustainable and economically viable. That our timber-oriented traditional management system has not been successful on either count, is manifested in the all round degradation of the forests. All that it has been able to achieve is to render the forests into an open access common property resource by excluding people from the management gamut. The alienation of the people has also led to technological failures. Due to tenurial insecurity, forestry research has also been languishing.

The effect of rapid degradation of forests on the policy makers has been varying over time but has rendered them progressively more conservative. Thus, beginning with the 1952 national forest policy, which squarely blamed the forest fringe dwellers for all the malady, the country passed through a plantation (of quick growing species) phase, then social forestry phase and finally ending up with Forest Conservation Act 1980 and its amendment in 1988 under which clear felling of natural forests has been virtually banned. Although this act has successfully arrested the prevailing trend of diverting forest lands for non-forestry purposes, it has also brought about a significant reduction in the area for felling. This reduction in logging has also resulted in a sizeable reduction in the employment it generated. Without an economic incentive, it is very difficult to sustain community interest in conservation. An alternate source of employment has to be generated. There are, however, vast areas of forests where there is logging activity and yet the area is suffering from degradation due to unregulated use by the community. In order to seek people's co-operation in the matter of conservation, the forests will have to be put to some productive use. It is quite unrealistic to expect people to conserve forests while they starve.

NTFPs have a big role to play here. Sustainable extraction of NTFPs together with processing and marketing can generate significant income and economy. In fact, in terms of employment as well as income, NTFPs in many instances have been found to give better returns than commercial logging. In West Bengal, investigations along this line are on and it is expected that before long, a dependable data base will emerge. However a few case studies, which are indicative in nature, are discussed below.

A study conducted by Ramkrishna Mission Lokshiksha Parishad in Raigarh, FPC (Forest Protection Committee) in Bankura District in 1992, shows that the FPC members began large scale collection and disposal of NTFP only 6 to 7 years ago when they formed the FPC and started conserving the forests. The FPC members depend upon forestry and allied production systems to a significant extent, as agricultural productivity is extremely low here. Tables-1 and -2 show the changes in the annual labour use pattern both for male and female. The FPC was formally registered in 1990.

Figure 1 shows the availability and collection of the NTFPs round the year as worked out by R K Mission. It will be seen from the figure that employment generated through NTFP covers the agricultural lean periods.

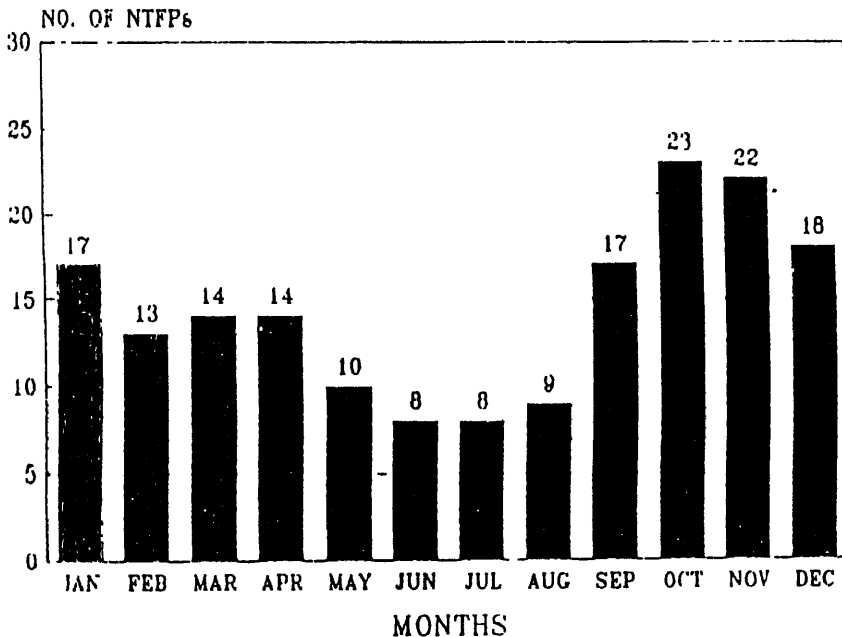


Fig 1: Annual NTFPs collection calendar of Raigarh FPC

Similarly, another case study carried out by K C Malhotra and others in Jamboni Range, Midnapore District, West Bengal, primarily in sal coppice

Table-1: Annual Labour Use Pattern (Male) of Raigarh FPC

	Wood Collection		Farm Activity		Migratory Labour		NTFPs Collection		Off-Farm Activity	
	%	Days	%	Days	%	Days	%	Days	%	Days
Before FPC Formation	47	170	12	45	12	45	12	45	18	60
After FPC Formation	14	50	8	30	25	90	41	150	12	45
Change	-33	-120	-4	-15	13	45	29	105	-6	-15
Analysis										

1 Wood collection gone down by 33% which is very significant

2 NTFPs collection has gone up by 29% which is almost matching (1) above

3 Farm activity has gone down because of adverse land/man ratio

4 Percentage of migratory labour has gone up as a natural consequence

5 Off-farm activity has gone down due to (1) above

Note Average engagement of a male FPC member during a year

Table-2: Annual Labour Use Pattern (Female) of Raigarh EPC

	Wood Collection		Farm Activity		Migratory Labour		NTFPs Collection		Off-Farm Activity	
	%	Days	%	Days	%	Days	%	Days	%	Days
Before FPC Formation	40	145	8	30	12	45	27	100	12	45
After FPC Formation	34	125	8	30	25	90	25	90	8	30
Change	-6	-20	0	0	13	45	-2	-10	-4	-15

Analysis

- 1 Wood collection has gone down marginally as collection for domestic use continues
- 2 NTFPs collection has also marginally gone down because male domination in collection specially of medical plants
- 3 Percentage of migratory labour has gone up
- 4 Farm activity remains as it is
- 5 Off-farm activity has also gone down

Note Average engagement of a female FPC member during a year

forests (K C Malhotra *et al.*, 1991) where 216 households (tribal 109, caste 107) belonging to 12 FPCs were examined, led to the following findings

- i) Of all the large natural biodiversity available in the sal forests, a significant portion is used very frequently by the local communities for subsistence needs of food, fuel, fodder, medicine, household articles and religious and ornamental purposes,
- ii) A significant proportion of the annual income of the households is derived from NTFPs. On an average, it amounts to 16.44%, and
- iii) The income derived from the harvested-poles is only one-third of the income from NTFPs over the same period.

Again the study conducted by R K. Mission Lokshiksha Parishad mentioned earlier showed considerable price difference of products between primary collectors and wholesalers (Tables-3 and 4). The Tables also show that but for successive cuts imposed by the intermediaries, they (i.e. FPC members) would have got a good price for their produce.

The case studies show that communities dependent on forests can have sustainable income from the NTFPs provided the extraction does not exceed maximum sustained yield. From the case studies it is also clear that NTFPs can provide the communities with a periodic income over continuous periods and take care of their cash flow problems. Besides, the income generated through NTFPs generally go to the landless or women and thus equity issues are also taken care of.

It is estimated that 328 families of flowering plants of NTFPs (with 21,000 species) out of 425 families in the world occur in India (Tewari, 1991). NTFPs have been estimated to account for 40% of the state forest revenues and about 75% of net export earnings from forest produce in India, generating about 2 million person years (World Bank, 1993) of employment. Besides, NTFPs provide some kind of a food security for a large number of people, especially tribals during droughts or famines, since they mostly depend on marginal agriculture. Although data on the subject are not available, it is estimated that about 30% of the diet of Maharashtra based tribal groups, living near the forests is derived from the forest. Similarly, in South-West Bengal, tribal groups collect 27 commercial products, 39 plant food products and 47 medicines for human or animal use (World Bank 1993). The food products include, leaves, vegetables, fruits, nuts, bamboo shoots, small animals and honey.

The following findings on NTFPs (based on Gupta & Guleria, 1982) have important bearing on JFM. They are

- i) about 40% of revenue and 55% of employment in the Indian Forestry Sector is attributed to NTFPs,
- ii) the growth of revenue from NTFPs was 40% higher than timber during the 1968-69-1976/77 period,

Table-3: Status of NTFPs (Medicinal) Transaction at Raigarh FPC of Rantbandh Range at the Primary Collectors Level

Sl No	Local Name	Latin Name	Number of Families Collecting Yr	Pers- ons En- gaged in NTFP Col- lection	Days En- gaged in NTFP Collec- tion per Year	Quant- ity of Collec- tion per Year (Kg)	Income per NTFP (Rs)	Aver- age Selling Price (Rs)	Aver- age Qty Coll- ected/ Pers- on/ Yr (Kg)	Aver- age Qty Collec- ted Fami- ly/Yr (Kg)
1	Amlaki	<i>Embluca Officinalis</i>	5 00	13 00	198 00	105 00	150 00	1 43	8 08	21 00
2	Anantamul	<i>Hemidesm- us indicus</i>	2 00	7 00	560 00	57 00	94 50	1 66	8 14	28 50
3	Arjun Chal	<i>Terminal- ia arjuna</i>	4 00	12 00	360 00	430 00	212 00	0 49	35 83	107 50
4	Bahera	<i>Terminalia bellirica</i>	7 00	18 00	265 00	514 00	220 00	0 43	28 56	73 43
5	Bankuthilat		3 00	8 00	120 00	75 00	40 00	0 53	9 38	25 00
6	Bel	<i>Aegle marmelos</i>	6 00	16 00	374 00	756 00	895 60	1 18	47 25	126 00
7	Bhaluksukti	<i>Oroxylum indicum</i>	3 00	9 00	366 00	200 00	200 00	1 00	22 22	66 67
8	Chatchni Chal	<i>Alstonia scholaris</i>	4 00	11 00	172 00	165 00	107 50	0 65	15 00	41 25
9	Dhadki Phul	<i>Woodfor- dia flori- bunda</i>	8 00	19 00	262 00	815 00	407 50	0 50	42 89	101 87
10	Hantaki	<i>Terminalia chebula</i>	5 00	14 00	284 00	319 00	201 90	0 63	22 79	63 80
11	Harula Chal	<i>Callicarpa arborea</i>	4 00	12 00	420 00	264 00	161 25	0 61	22 00	66 00
12	Kalmegh	<i>Androgra- phis paku- culata</i>	7 00	17 00	400 00	1490 00	1139 0	0 76	87 65	212 86
13	Kantakari	<i>Solanum xantho- carpum</i>	4 00	11 00	184 00	420 00	384 60	0 92	38 18	105 00
14	Kathdi		1 00	2 00	20 00	60 00	60 00	1 00	30 00	60 00
15	Kurchi Chal	<i>Holarrhe- na antidys- enterica</i>	6 00	15 00	390 00	666 00	293 00	0 44	44 40	111 00
16	Lodh Chal	<i>Symplocos racemosa</i>	8 00	19 00	440 00	1125 00	655 00	0 58	59 21	140 63
17	Mahadev Jata		4 00	11 00	292 00	462 00	431 00	0 93	42 00	115 50
18	Palas Phul	<i>Butea mon- osperma</i>	6 00	15 00	153 00	399 00	169 20	0 42	26 60	66 50
19	Rohini	<i>Sourmida febrifuga</i>	2 00	7 00	120 00	90 00	44 00	0 49	12 86	45 00
20	Satamuli	<i>Asparagus racemosus</i>	4 00	11 00	442 00	100 00	122 50	1 23	9 09	25 00
21	Sonaphal	<i>Oroxylum indicum</i>	1 00	3 00	60 00	6 00	3 60	0 60	2 00	6 00
TOTAL			94 00	250 00	5882 00	8518 00	5992 15	16 48	614 13	1608 51

Table-4: Status of NTFPs (Medicinal) Transaction at Wholesellers Level

Sl No	Local Name	Latin Name	Total Qty of NTFP Collected (Kg)	Total Qty of NTFP Sold (Kg)	Total Cost of NTFP (Rs)	Total Income from NTFP (Rs)	Profit per NTFP (Rs)	Average Purchase Price per NTFP (Rs)	Average Selling Price per NTFP (Rs)
1	Amlaki	<i>Embolica officinalis</i>	620	310	920 00	1395 00	475 00	1 48	4 50
2	Anantamul	<i>Hemides-mus indicus</i>	500	200	1750 00	1800 00	50 00	3 50	9 00
3	Asalchakul-ta		4500	2000	4000 00	12500 00	8500 00	0 89	6 25
4	Babla Chal	<i>Acacia nilotica</i>	1200	600	1200 00	1800 00	600 00	1 00	3 00
5	Bahera	<i>Terminalia bellirica</i>	1600	3800	2900 00	6900 00	4000 00	0 38	1 82
6	Bel	<i>Aegle mar-melos</i>	14000	7500	14000 00	41250 00	27250 00	1 00	5 50
7	Bel Beej	<i>Aegle mar-melos</i>	1000	500	500 00	1750 00	1250 00	0 50	3 50
8	Bhaluksuk-ti	<i>Oroxylum indicum</i>	400	200	200 00	700 00	500 00	0 50	3 50
9	Dhadki Phul	<i>Woodfordia floribunda</i>	4250	2000	2125 00	12000 00	9875 00	0 50	6 00
10	Haritaki	<i>Terminalia chebula</i>	14400	7200	7200 00	26800 00	18600 00	0 50	3 58
11	Harula Chal	<i>Callicarpa arborea</i>	1000	500	850 00	1900 00	1050 00	0 85	3 80
12	Jam Phal	<i>Syzygium cumini</i>	2650	1700	1525 00	5700 00	4176 00	0 58	3 35
13	Kalmegh	<i>Andrographis paniculata</i>	29750	9500	14875 00	35000 00	20125 00	0 63	3 68
14	Kantakari	<i>Solanum xanthocarpum</i>	2500	1000	2500 00	9000 00	5500 00	1 00	9 00
15	Kurchi Beej	<i>Holarrhena antidysenterica</i>	1900	900	13200 00	8000 00	-5200 00	6 95	8 89
16	Kurchi Chal	<i>Holarrhena antidysenterica</i>	2400	1200	1740 00	3500 00	1600 00	0 72	3 00
17	Lodh Chal	<i>Symplocos racemosa</i>	6600	3300	4100 00	8250 00	4750 00	0 62	2 50
18	Aata Phal	<i>Caesalpinia crista</i>	2000	1000	7000 00	22000 00	1500 00	3 50	22 00

(Contd)

Table-4: (Contd)

Sl No	Local Name	Latin Name	Total Qty of NTFP Collected (Kg)	Total Qty of NTFP Sold (Kg)	Total Cost of NTFP (Rs)	Total Income from NTFP (Rs)	Profit per NTFP (Rs)	Average Purchase Price per NTFP (Rs)	Average Selling Price per NTFP (Rs)
19	Palas Beej	<i>Butea monosperma</i>	1500	600	1500 00	4200 00	2700 00	1 00	7 00
20	Palas Phul	<i>Butea monosperma</i>	3750	1500	3000 00	4900 00	2469 00	0 80	4 00
21	Salpani		2250	900	2812 50	6500 00	3487 50	1 25	7 00
22	Sarpagandha	<i>Rauvolfia serpentina</i>	350	140	5600 00	9100 00	3500 00	16 00	65 00
23	Satamul	<i>Asparagus racemosus</i>	375	150	937 50	2400 00	1452 50	2 50	16 00
24	Sona Phal	<i>Oroxylum indicum</i>	200	100	150 00	200 00	50 00	0 75	2 00
TOTAL			99695	46800	94585 00	227545 00	118260 00	47 40	203 87

- iii) exports earnings from NTFPs on the average account for 60-70% of the total export earnings from forest products. The export earning on account of forest products has been rising steadily,
- iv) Current production of most of the NTFPs is only 60% of the potential production, and
- v) in Madhya Pradesh, NTFPs worth \$ 700 million are collected annually. The collection is primarily done by tribal women (World Watch, 1991)

EXPLOITATION OF NTFPs

Studies carried out so far, although insufficient, reveal that a host of NTFPs carry some economic value and are likely to provide a sustainable income to the communities. But the very base of this resource is being eroded due to Govt attention being paid only to a few selected valuable items of NTFPs like Tendu leaves, Sal seeds, Katha, resin, etc. Contractors involved in extraction try to maximise collection even at the cost of trees or other NTFPs.

Besides, a lot of NTFPs are exploited surreptitiously or with nominal permits. In a timber-oriented forestry culture, the foresters are not overly concerned with this. The result is, the more valuable of these are being exterminated and may be lost for all time to come. It is, therefore, absolutely necessary to make inventories of NTFPs available in forest areas and regulate extraction to a sustainable level. A detailed knowledge of the ecological conditions under which they thrive, their regeneration status, and methods of artificial regeneration are required to be known urgently.

The ecological changes that will take place over time with protection, will regulate growth and development of NTFPs apart from the broad changes in the vegetational composition on a longer time profile. This will certainly have economic parameters affecting the JFM. Participatory Research with forest department, FPC members and NGOs acting together, will be necessary to put the data in place quickly.

ARTIFICIAL REGENERATION OF NTFPs

Not much attention has been paid to this item even at the national level so far. During 7th five-year plan, some centrally sponsored schemes have been introduced for raising bamboos with myrabolans and fuel with fodder. The 7th plan target for NTFP planting is only 85000 ha. as against a total afforestation target of 9 m ha. Such efforts without people's support are not likely to yield desired results. Even social forestry schemes had little concern for NTFPs. In the plantation forestry, there is a tremendous scope for introducing NTFPs in the form of multipurpose trees as well as shrubs, herbs and grasses as intercrops. The introduction of an intercrop will ensure a flow of intermediate benefits to the community groups so essential to sustain their efforts. In fact, in West Bengal Forestry Project where the strategy adopted is JFM, an important component is, raising multi-tiered plantations with intercrops of NTFP (WBFP, 1991).

NATIONALISATION OF NTFPs

Some more important NTFPs like Tendu leaves, Sal seeds, etc., have been nationalised in states like Madhya Pradesh, Orissa, Bihar, etc. One of the cardinal objectives of nationalisation must have been ensuring a fair deal to the primary collectors, as well as securing the production base. But in effect, the reverse is happening. In M P, the production of Tendu leaves fell from 5.10 million bags in 1981-82 to 3.9 million bags in 1985-86. In Orissa, despite nationalisation, the production of Tendu leaves has remained stagnant almost over a period of two decades (LBSNAA 1994).

Similarly, the wage rates in the case of Sal seeds in Madhya Pradesh and in the case of Tendu leaves in Orissa have significantly dropped in real terms during the period from 1967 to 1984 (LBSNAA, 1994). Although no such analytical study is readily available for the subsequent period, the same trend seems to continue.

The reasons as to why despite good intentions, nationalization should result in this have been summarised below (Chambers, 1990).

Nationalization reduces the number of legal buyers, chokes the free flow of goods, and delays payments to gatherers, as government agencies find it difficult to make prompt payments. This results in contractors entering from the

back door, but they must now operate with higher margins required to cover uncertain and delayed payments by government agencies, as well as to make police and other authorities ignore their illegal activities. This all reduces tribals' collection and incomes.

Not only this, in the present arrangement, the FPC members/collectors are only getting wages for collection but are not getting a share of the revenue, net or gross, in terms of the JFM resolutions. The issue becomes particularly significant when viewed in the context of Bidī Industry's total turnover being 3000 crores in 1988-89 and the expected turnover for 1989-90 being a staggering 5000 crores. The bidī industry employs some 50 lakh labourers in a dozen states (*India Today*, Nov 15, 1989). The community groups, bulk of whom are tribals, will have substantial economic gains if the equity issues are sorted out rationally. This will also go a long way to provide economic support to JFM in several states in the country.

SUPPORT ACTIVITIES IN JFM

Community dependency on forests has to be reduced if the forests are to be conserved. The forests cannot provide for all the different needs of a rapidly growing population. One important way of doing this is by promoting support activities. These support activities include sericulture, lac cultivation, orchid propagation, bee keeping, basket weaving, rope making, sal plate making, bidī making, etc., apart from collection and processing of a host of other NTFPs. Most of these items are dependent on the availability of NTFPs in the natural forests or on intercrops in artificially raised plantations. All these support activities, therefore, require linkages to be established with the NTFPs occurring in the forests. In microplans drawn up in Joint Forest Management, the availability of a particular NTFP in the specific forest area and the support activity it can generate must find a place. The number and composition of the group identified as suitable for taking up a particular NTFP based support activity should also be recorded in on the microplan.

PRESERVATION OF BIODIVERSITY

Tropical forests are rich in biodiversity and must be preserved not only for their scientific value but for the maintenance of life (Solbrig, 1991). Bulk of India's forest being tropical, preservation of biodiversity must be one of the major objectives of forest management. Large scale logging that has been practised in the country over the years, tends to over exploit the useful species and destroy the unwanted ones. All artificial regeneration activity also favours the economically more valuable ones while neglecting the others. This has resulted in a systematic loss of species. It is, therefore, considered unwise in the present context

to promote any exhaustive use of forest resources. In contrast to logging, most NTFP activities rely on non-destructive harvesting of annually renewable plant parts provided extraction rates do not exceed the maximum sustainable yield. Harvesting forests primarily for NTFPs may be a relatively benign and ecologically sustainable activity, (Tewari 1993).

Joint Forest Management relies heavily on renewal of degraded natural forests. With reduction in the area under logging, sustainable harvesting of NTFPs only will provide employment and support to the community groups. It has to be realised that in a country where millions depend on the forests for their sustenance, we cannot keep such natural resources under lock and key. Bringing forests under JFM and managing them for NTFPs on a sustained basis is perhaps the only way to achieve a large scale restoration of biodiversity. It is also estimated that the production potential of NTFPs is 2.5 to 10 times the current rate and employment generation could be four times higher than the current level (Gupta & Guleria, 1982).

MANAGEMENT OF NTFPs

NTFPs require to be managed. They need research support, valuation, processing, value-addition through forest based small enterprises. When forests were in abundance, operational restrictions on NTFPs were less and NTFPs were primarily harvested for subsistence needs and barter trade, as markets were virtually non-existent. In an open access situation, some items of NTFP were overexploited without creating any special concern in the minds of foresters. The economically more important items were either nationalised or put under special working circles in the working plans. NTFPs were commonly viewed as secondary by-product of timber production process and were undervalued by the foresters. The economists ignored these as the NTFPs did not enter market economy to any great extent. Botanists and anthropologists are usually more concerned about the variety and range of species and their uses.

In view of the involvement of the communities in the conservation and development of forests, and the clearly defined tenurial rights, and in recognition of the fact that the NTFPs may provide a sustainable source of income to the communities participating in JFM, the role of NTFPs may be augmented in the following manner:

- i) generating a basket of information on NTFPs after collecting the same from across the country and if possible across tropical countries, especially on regeneration, both natural and artificial, extraction methods, collection, processing, storage and marketing,
- ii) dissemination of the information on a regular basis to different states, and
- iii) intensifying research efforts both at the field as well as in the laboratories.

Joint Forest Management is only a strategy adopted to fulfil certain

objectives of which scientific management of forests is one. It has also to be accepted that despite substitution, the demand for wood will increase with the rise in population.

Therefore, production of wood has to increase through growing of trees both inside and outside forests. Where natural forests will be preserved following a working plan mandate or in pursuance of Forest Conservation Act, the management of NTFPs becomes the key subject. It is however, not clearly known, what degree of intervention is possible to favour certain economically more important items of NTFP and with what result. In a sal forest, even mere protection can bring about ecological changes which may have important economic bearing on management. With the renewal of sal forests, tendu plants get shaded out, production of sal seeds goes up and production of fungi, etc., (mostly edible) also increases. When, however, forests are worked on a coppice relation of 10 or 15 years the sudden opening of the canopy will certainly have profound effect on the regeneration of NTFPs. In JFM, the overall objectives should perhaps be to adopt a strategy to maximise benefits from forest management for local communities. In certain situations, a low intensity timber extraction can be combined with NTFP management to optimize the overall economic gains. The risks will also be evenly shared in this. All these require detailed studies to be carried out in natural forests as well as in artificially raised plantations in different vegetational zones so that management decisions are taken on a sound basis.

CONCLUSION

Non-timber forest products apart from constituting a major portion of the revenue derived from the forests, also provide subsistence and income to a large population of forest-fringe-dwellers, and so deserve special attention from the policy makers, foresters and economists. We have to integrate the NTFP component with tree management and this must be silviculturally acceptable and ecologically viable. It has also to be accepted that NTFPs cannot provide a sole source of income to the rural user, it can only supplement his income from other streams and perhaps help him to tide over lean periods.

In microplans drawn for the communities in JFM, programmes based on NTFPs should be stated in clear terms which should also address equity issues connected with collection, processing, marketing as well as training. The forest Department's role should be that of a facilitator, provider of technical and market information and a communication expert.

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Role of NTFPs in JFM

D.D. Tewari

INTRODUCTION

The roots of the current Joint or Participatory Forest Management Programme (JFM) in India can be traced back to the Arabari experience in W Bengal in 1973. In Gujarat, JFM was initiated as late as 1986. As per the Principal Conservator of Forests (PCF), Forest Department, Gujarat, some 1000 villages are under or in the process of adopting JFM programme in Gujarat. About 2% of the total forest area of the state is potentially available for the JFM programme

The actual adoption and success of JFM depends on the collective efforts of people towards organising protection for the forests and providing economic benefits to people — the magnitude and the timings of economic benefits being the important aspects emanating under the JFM programme. Further, since JFM is basically a community based forestry programme, sustenance of this institution depends upon the continuing interest of the community in the programme.

Chief objectives of JFM are regeneration, conservation, development and management of degrading forests of India through community participation on a sustained basis. These objectives can be achieved only if people participating in it can be assured of gainful economic remunerations, which in turn are dependent on the magnitude and timing of harvest of various products from a forest crop.

The present paper is a report on the role of Non-Timber Forest Products (NTFPs) in Joint Forest Management and how JFM has been attempted as an attractive, successful package/venture for NTFPs rejuvenation for forest-dwelling/dependent communities.

OBJECTIVES

A study of the Soliya village in Bharuch District in Gujarat was undertaken with a number of objectives. The knowledge of economic flows emanating thus from such jointly managed forests was found to be crucial for policy making, further evaluation of the programme and in deciding how the benefits between the Forest Department and the Community would be sharable. The major objectives of this case-study were as follows:

- 1) assessment of area and conditions that led to building up of linkages for a common goal—JFM,

- ii) assessment of the supporting factors cementing the linkages into an institution,
- iii) assessment of the institutional functioning—the constraints therein and the role of Forest-Department, and
- iv) analysis of control mechanisms in the conservation of resources and the effectiveness of the institution.

LOCATION OF THE SOLIYA VILLAGE

Soliya village is located in Dedia-pada Taluka of Bharuch District in Gujarat. It is situated at a distance of 26 km from Netrang, 18 km from Dediapada and 42 km from Rapippla via Khakar, at the bank of Karjan river. It is surrounded by hills with a highly undulating topography.

Soliya is the largest village in the Dediapada Taluka. The river Karjan flows on the western border of the village and Pangam, Dhanor and Magardeve villages surround Soliya from all other sides. The north end of the village has some hilly areas with nearly sandy loam soil while the south end of the village is characterised by rocky areas and medium black soil. The central belt of the village is relatively fertile. In terms of commercial vegetation, bamboo predominates in the north and south ends of the village where the soil is not very fertile while both teak and bamboo are very common in the central fertile belt.

GENERAL RESOURCE POSITION OF SOLIYA

The total area of the village is about 814 hectares, out of which 380 hectares (46.67%) are under private ownership, 388 hectares (47.71%) are owned by the Forest Department, some 20 hectares are revenue wastelands, 10 hectares are gaucher lands (grazing) and 15 hectares fall in the unclassified category. The privately owned land is basically farmland which is mainly rainfed. Only 4 hectares are irrigated and the rest 375 hectares are dependent on monsoons. About 343 hectares of village land is under agricultural cultivation with crops like cereals, pulses, oil seeds, vegetables and fibre crops. Cereals occupy some 45% of the total sown area, pulses 34%, fibre crops 5%, oilseeds 15% and the vegetables — the rest 5%. Among cereal crops, jowar, bajra and maize and dry paddy are major crops and form the staple food of villagers.

There is a division of labour between men and women, with the ploughing operations being primarily done by the men. Women perform other operations such as weeding, harvesting, thrashing and winnowing. Children also provide labour for agricultural operations.

Soliya is a tribal village comprising mostly the Vasava community. During 1993, there were some 320 households in the village, comprising a total population of 2100 people — 900 adult males, 800 adult females and 400

children aged below 15 years. Thus, children constitute only 19% of the total population.

Vasava community people are basically agriculturists or farmers. A few households (4) belong to the Kotwaliya community — a migrating community, basically wage labourers, going from one village to the other in search of employment. Some (3) households belong to Rohit community — basically cobblers who provide service to all villagers. Rohits and Kotwaliyas are lower income, landless class groups.

Some Vasava households were also found to be landless. In all, about 10-15 households are landless in the village, i.e., landless labourers. Other 10-15 households have land holdings of more than 4 hectares (10 acres) or so. The remaining households have land between 1.25 to 2 hectares. However, most farmers are of marginal type with land holdings of less than 1 hectare only.

Livestock is also an important resource of the village and is the source of draught-power for agriculture, milk and meat for meeting the nutritional needs of the people. On an average, there are 5 animals per household. Buffaloes constitute some 66% of the total livestock population and are reared for their milk, whose yield is almost three or four times that of the cow. Oxen or bullocks constitute 17.6% of total livestock population and are the sole source of draught-power. Oxen are priced very highly and are brought to Gujarat by Rajasthan traders. Conspicuous absence of sheep is noted.

CULTURE AND RELIGION

Soliya villagers are all tribals and are guided chiefly by religion in their culture and social life. Besides Ganesh Puja, Navratri, Dev Puja (specific puja of the tribals) are performed by the tribals to venerate land as God. Villagers also celebrate Bhoomi Puja jointly and believe it to bring peace and prosperity to the villagers.

EDUCATION AND HEALTH CARE

The state of education is very poor in this village with the village children either working on farms or going out in search of wages. On the whole, villagers in Soliya have not realised the importance of education.

The health care of the villagers is rather good when compared to other villagers but is certainly not satisfactory from the viewpoint of health care standards of the country. One Primary Health Centre (PHC) has been set up in the village but has been of no major help to Soliya residents. One of the common endemic diseases, locally called 'Khas' affects the children in the village because they swim in the waters of the Karjan river, dirtied by the decomposition of sun-hemp — a local plant.

FORMATION AND FUNCTIONING OF THE GRAM VIKAS MANDAL (GVM)

A number of organisations built up in Soliya became non-functional or defunct on account of one reason or the other. During early 1980s, however, people began to get organised into forming a Gram Vikas Samiti (GVS or Village Development Council) under Dr. Parikh. Later in 1985, the Agha Khan Rural Support Programme (AKRSP) approached the Divisional Forest Officer, Rajpipla for his approval for initiation of Joint Forest Management Programme in Soliya village and under this programme, AKRSP adopted the Soliya village for afforestation. AKRSP formed the Gram Vikas Mandal (GVM). The pre-existence of GVS facilitated the formation of GVM.

The GVM in 1985 was a sort of informal organisation and had a total of 50 members. All members were landless. Later, landed members were also added to it. In June 1993, its total general body membership was about 183—more than 3 fold increase in the membership population. There is a President and a Secretary and a total of 12 executive members. The Vasava community—the majority in the village—supports the new initiative of village organisation. The executive committee has 2 women members as part of this decision making unit.

The criterion for membership of GVM has changed considerably since starting of GVM in 1985. Initially in 1985, only landless villagers were members. The criteria of membership was that one who would contribute labour towards forest protection can become a member. Initially, only 50 people joined the programme. Later, landed people were also made members who agreed to the 'principle of labour contribution'.

The improved performance of JFM programme attracted more people and several people were now willing to be GVM members. A life time membership fee of Rs 11/- per person which would include a share of Rs 10 in the society and Rs 1/- as entry fee was introduced. The AKRSP prepared villagers psychologically to participate in the afforestation programme, informing them of the employment opportunities so generated in the plantation work as also take the participating people in confidence so that they devote time to protect the afforested lands.

Despite some problems arising due to 'wage payment to villagers for plantation work' for their contributed labour in the jointly managed venture and launching of rival Gram Vikas Mandal (GVM) with the blessings of Forest Department, a triangular relationship is seen to be formed between Village Community (VC), Forest Department (FD), and Agha Khan Rural Support Programme (AKRSP). This relationship is very delicate and sensitive with indirect communication channels. Community is the central focal point. The communication between FD & VC and between AKRSP and VC is direct and

the possibility of feed back is ample. However, communication between FD and AKRSP is very loose and unstructured and needs dialogue to clear up misunderstandings.

The GVM in Soliya, an institutional innovation to meet various multiple community needs, performs various functions which may be classified into 4 categories:

- i) forest protection and marketing function,
- ii) banking function,
- iii) medical insurance functions, and
- iv) input-supplying agency function.

The major objective of GVM is organising protection of forests, organising the schedule of protection duty, fines for members who skip their duties and design punishment criteria for members and non-members who steal from forests

GVM also functions as a bank for the villagers, People working in the afforestation programme are paid through GVM. The individual is paid after making 2 types of deductions at the source

- i) GVM commission deduction (GCD), and
- ii) Individual's savings deductions (ISD)

The GVM commission deduction is used for maintaining the GVM office, for buying implements like pesticides, sprayers and sugarcane crusher, for paying wages to watchmen during monsoon season, etc. The implements are rented out to farmers for various uses. The GVM deductions are thus community savings. The individual's savings deductions are kept by the GVM in the individual account with GVM and the records are meticulously maintained. Members can take loans against these savings from GVM and pay interest. From the generated funds, the GVM lends money to members to buy agricultural inputs such as hybrid seeds, pesticides and fertilisers. These are bought from nearby markets and retailed in the village. Thus, the GVM performs the role of an input-supplying agency. The GVM supplies of inputs such as seeds or fertilizers with loan facility come in handy to villagers. The GVM also provides instant loan facility for medical help.

ROLE OF FOREST (NTFPs) IN THE VILLAGE ECONOMY

Soliya village has 3 types of forests which may be useful for extracting different kinds of benefits. These forests are.

- i) reserve forests,
- ii) revenue forests, and
- iii) jointly managed forests

Village has access to nearby reserve forests which are being managed by the Forest Department. After 1986, afforestation work initiated on the revenue wastelands and lands surrounding villages, owned by the Forest Department has resulted, in a decline of dependence on reserve forests.

Forests form an integral part of lifestyle of village people. People derive and acknowledge multiple benefits from forests. Various benefits emanating from forests that people use can be classified into 4 categories.

- i) economic benefits,
- ii) ecological benefits,
- iii) community related benefits, and
- iv) cultural benefits.

Villagers accept that the economic benefits are the major attraction to them though other benefits are equally important.

Economic benefits include both timber and non-timber products. While non-timber products become available in the early and mid-stages of forest growth, timber becomes available at the end. Most commonly collected NTFPs include timru leaves, khakhar leaves, asitra leaves, mahua flower and seeds, baheda fruits, amla fruits, karanj seeds, saag seeds, modad seeds, haldu seeds, bamboo seeds, khair seeds, sewan seeds, tado seeds and flowers, ambo fruits, bila fruits, umba fruits, khattu umba and so on (Tables-1 and -2)

Table-1: Major Uses of Various NTFPs, Solhya

Sl No	Local Name	Common Name	Part Used	Uses
1	Timru	Tendu Patta	Leaves	Bidi
2	Khakra	Palas	Leaves	Bidi, Cup & Plates
3	Asitra	Katchnar	Leaves	Bidi
4	Mahudo	Mahua	Flower	Medicine & Alcohol
5	Mahudo	Mahua	Seed	Oil
6	Baheda	Bahera	Fruit	Fruit
7	Amla	Amla	Fruit	Oil
8	Karanj	Karanja	Seed	Seed Oil
9	Saag	Teak	Seed	To sell
10	Modad	Modal	Seed	To sell
11	Hardad	Haldu	Seed	To sell
12	Vans	Bamboo	Seed	Food
13	Khair	Khair	Seed	To sell
14	Sewan	Sewan	Seed	To sell
15	Tado		Fruit & Flower	Alcohol
16	Ambo	Mango	Fruit	Food & To sell
17	Kowad	Karaya	Gum	Gum
18	Bila	Bael	Fruit	Food
19	Umba	Umba	Fruit	Food
20	Khatumba	Kusum	Fruit	Food

(Contd)

Table-1: (Contd)

Sl No	Local Name	Common Name	Part Used	Uses
21	Ambli	Imbli	Fruit	Food
22	Gorasambli	Vilayati Imbli	Fruit	Food
23	Al	Al	Flower	Medicine
24	Gugad	Gugad	Gum	Gum
25	Soghad	Soghad	Seeds	
26	Rantog Goyand		Leaves & Fruit	Neera
27	Himada			Medicine
28	Alu Kakad			Medicine
29	Hud pad			Medicine

Source Based on discussion with AKRSP officials, villagers, and Forest Department officials

Table-2: Estimates of Collection of Various NTFPs by Soliya Villagers, 1992-93

Sl No	Local Name	Common Name	Part Used	Amount Collected Per Annum
1	Timru	Tendu Patta	Leaves	2,00,000 Pudas
2	Khakra	Palas	Leaves	75,000 Pudas
3	Asitra	Katchnar	Leaves	1,00,000 Pudas
4	Mahudo	Mahua	Flower	20 Qtls
5	Mahudo	Mahua	Seed	3 Qtls
6	Baheda	Bahera	Fruit	1 Qtl
7	Amla	Amla	Fruit	2 Qtls
8	Karanj	Karanja	Seed	40 Kgs
9	Saag	Teak	Seed	40 Kgs
10	Modad	Modal	Seed	15 Kgs
11	Hardad	Haldu	Seed	14 Kgs
12	Vans	Bamboo	Seed	100 Kgs
13	Khair	Khair	Seed	20 Kgs
14	Sewan	Sewan	Seed	60 Kgs
15	Tado		Fruit & Flower	500 ltr
16	Ambo	Mango	Fruit	25 Qtls
17	Kowad	Karaya	Gum	12 Qtls
18	Bila	Bael	Fruit	30 Kgs
19	Umba	Umba	Fruit	30 Kgs
20	Khatumba	Kusum	Fruit	20 Kgs
21	Ambli	Imbli	Fruit	100 Kgs
22	Gorasambli	Vilayati Imbli	Fruit	20 Kgs
23	Al	Al	Flower	40 Kgs
24	Gugad	Gugad	Gum	100 Kgs
25	Soghad	Soghad	Seed	20 Kgs
26	Rantog Goyand		Leaves & Fruit	10 Kgs
27	Himada			500 Gms
28	Alu Kakad			500 Gms
29	Hud pad			500 Gms

Source Based on discussion with AKRSP officials, villagers, and Forest Department officials

Timru leaves collection is a major activity in terms of value and volume, while the production of khakar and asitra leaves is to a lesser extent

Most NTFPs are collected during summer from April to May, when villagers are rather free from agricultural work and use this free time to supplement their incomes through NTFP collection. Mostly women are engaged in the collection. Table-3 gives the estimated time taken in collection and generating employment

Table-3: Time Taken in Collection of NTFPs and Estimated Employment Generation, and Labour Productivity, Soliya, Gujarat

Sl No	Local Name	Collection per Trip	Total Collection	Total Mandays	Total Value	Imputed Wage Rs / Day	Market Wage Rs / Day	Difference
1	Timru leaves	225 Pudas	2,00,000 Pudas	889 00	42,000	47 24	32	+ 15 24
2	Khakra leaves	125 Pudas	75,000 Pudas	600 00	8,250	13 75	32	- 18 25
3	Asitra leaves	110 Pudas	1,00,000 Pudas	1,136 00	25,000	22 00	32	- 10 00
4	Mahudo flower	20 Kgs	2,000 Kgs	75 00	4,000	53 33	32	+ 21 33
5	Mahudo seed	5 Kgs	3,000 Kgs	900 00	9,000	10 00	32	- 22 00
6	Baheda fruit	20 Kgs	1,000 Kgs	62 50	3,000	48 00	32	+ 16 00
7	Amla fruit	10 Kgs	2,000 Kgs	125 00	8,000	64 00	32	+ 32 00
8	Karanj seed	2 Kgs	40 Kgs	12 50	----	----	----	----
9	Saag seed	15 Kgs	40 Kgs	2 33	200	85 83	32	+ 53 88
10	Modad seed	0 5 Kg	15 Kgs	41 25	----	----	32	----
11	Hardad seed	0 5 Kg	14 Kgs	28 00	----	----	32	----
12	Bamboo seed	10 Kgs	100 Kgs	15 00	----	----	32	----
13	Khair seed	3 Kgs	20 Kgs	4 16	80	19 23	32	- 13 23
14	Sewan seed	5 Kgs	60 Kgs	12 00	270	22 50	32	- 9 50
15	Tado fruit/ flower	10 Ltrs	500 Ltrs	12 50	2,500	200 00	32	+ 168 00
16	Ambo fruit	250 Kgs	2,500 Kgs	15 00	17,500	1166 66	32	+ 1134 66
17	Kowad gum	0 5 Kg	25 Kgs	37 50	1,000	26 66	32	- 5 34
18	Bila fruit	20 Kgs	30 Kgs	1 13	----	----	32	----
19	Umba fruit	2 5 Kgs	30 Kgs	9 00	----	----	32	----
20	Khatlumba fruit	4 Kgs	20 Kgs	3 75	----	----	32	----
21	Ambli fruit	12 5 Kgs	100 Kgs	3 00	500	166 66	32	+ 134 66
22	Gorasambli fruit	5 Kgs	20 Kgs	0 50	100	200 00	32	+168 00
23	Al	3 Kgs	40 Kgs	8 30	----	----	32	----
24	Gugad	0 5 Kg	100 Kgs	300 00	4,000	13 33	32	- 18 67
25	Soghad	2 5 Kgs	20 Kgs	12 00	----	----	32	----
26	Rantog Goyand	1 Kg	1 Kg	1 50	40	26 66	32	- 5 34
27	Himada	0 1 Kg	0 5 Kg	7 50	----	----	32	----
28	Alu Kakad	0 5 Kg	0 5 Kg	1 50	----	----	32	----
29	Hud pad	---	0 5 Kg	---	----	----	32	----
Total		----	----	4040 92	1,25,400	34 00	----	----

* 1 Manday = 8 hrs

Source Constructed from data obtained from survey and based on discussion with AKRSP officials, villagers, and Forest Department officials

and labour productivity. In Soliya village, an annual employment of about 4000 man days is generated through collection of NTFPs (Table-4). Roughly, NTFPs worth Rs 90 thousand to Rs. 1.25 lac are collected annually besides the fuel-wood and fodder extracted by villagers for self-consumption. The aggregate imputed wage for collection comes around Rs.34 per day as opposed to the market rate of Rs. 32 per day. Looking at the differential between market and imputed wage rates, collection of timru leaves, baheda fruits, saag seeds is very profitable, with a very lucrative margin (Table-4)

In addition to the above NTFPs, fuel-wood and fodder are two important NTFP items which are collected from forests for self consumption purpose

Table-4: Period of Collection and Number of Men, Women, and Children Engaged in NTFPs Collection, Soliya, Gujarat

Sl No	Local Name	Collection Period	No. of Persons Collecting		
			Men	Women	Children
1	Timru	Apr - May	--	50	10
2	Khakra	Apr - May	--	25	--
3	Asitra	Apr - Oct	25	--	--
4	Mahudo flower	Apr - May	25	--	--
5	Mahudo seed	May - Jun	30	50	10
6	Baheda	Aug - Sep	10	30	30
7	Amla	Jul - Jan	10	5	--
8	Karanj	Mar - Apr	5	--	10
9	Saag	Mar - Apr	5	--	5
10	Modad	May - Jun	2	1	3
11	Hardad	Apr - May	5	5	2
12	Vans	Mar - Nov	10	10	--
13	Khair	Mar - Apr	15	7	5
14	Sewan	May - Jun	5	2	2
15	Tado	Mar - Jun	--	15	5
16	Ambo	Mar - Jul	50	15	25
17	Kowad	Jan - Dec	5	--	--
18	Bila	Mar - Jul	7	5	15
19	Umba	Jun - Jul	5	3	10
20	Khatumba	May - Jun	5	2	10
21	Ambli	Feb - Apr	10	20	25
22	Gorasambli	Mar - Apr	5	7	25
23	Al	Jul - Sep	10	8	25
24	Gugad	Jan - Dec	--	25	--
25	Soghad	Mar - Apr	5	2	1
26	Hidido leaves	Apr - May	2	1	5
27	Rantog Goyand	Jan - Dec	5	--	--
28	Himada	Jul - Sep	5	--	--
29	Alu Kakad	Jan - Dec	5	--	--
30	Hud pad	Jul - Sep	1	1	--

Source Based on discussion with AKRSP and Forest Department officials and villagers of Soliya

Fuel-wood supply in Soliya village is met mainly from reserve forests through cut-back arrangement and illegal extraction (Table-5). Since fuel-wood is not available in abundant amounts, alternatives or substitutes such as crop residues of tuber and cotton are used for cooking purpose. In addition, biogas plants recently set up help in significant savings of fuel-wood. While some households are presently totally dependent on forests for their fuel-wood requirements, other households have access to both crop residues and biogas. Expansion of biogas programme in the village can greatly reduce dependency on fuel-wood (Tables-6 and 7)

Table-5: Sources of Supply of Fuel-wood, Soliya, Gujarat

Sl No	Source	Amount of Fuel-wood Tonnes	Per cent of Total Tonnes
1	Through cut-back arrangement once in a year	300	45.25
2	Headloading		
	Allowed	242	36.50
	Illegal	121	18.25
	Sub-total	363	54.75
Total		663	100

Source: Based on survey and discussions with Forest Department officials and villagers of Soliya

Table-6: A Comparison of Households Using Different Mixes of Fuel-wood, Crop Residues, and Biogas and Their Fuel-wood Savings, Soliya, Gujarat

Household Type	Fuel-wood use per annum (Kgs)	Fuel-wood savings per annum (Kgs)	Relative fuel-wood savings per annum compared to household Type I (%)
Household Type I			
Having complete dependence on fuel-wood	2555	Nil	Nil
Household Type II			
Using crop residues for four months	2195	360	14.09
Household Type III			
Using crop residues for four months and biogas for the whole year	855	1700	66.53

Source: Based on survey

Table-8 depicts the average annual fodder and per day requirement for cows, buffaloes and goats. The total requirement for the entire village when all animals are stall-fed comes out to be about 16 thousand tonnes. Three-fourths of total fodder is consumed by buffaloes.

While buffaloes are preferred to cows and goats due to their large milk yield and relatively longer lactation periods, bullocks are important for their traction

Table-7: Distribution of Households Using Fuel-wood, Crop Residues, and Biogas and Their Fuel-wood Savings, Soliya, Gujarat

Particulars	Number of households	Total annual fuel-wood requirement	Total fuel-wood consumption	Fuel-wood savings from		Total fuel-wood savings
				Crop residues	Biogas	
	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes
Household Type I Having complete dependence on fuel-wood	93 (29.1)*	237.62	237.62	Nil	Nil	Nil
Household Type II Using crop residues for four months	172 (53.8)	439.46	377.54	61.92	Nil	61.92
Household Type III Using crop residues for four months and biogas for the whole year	55 (17.2)	140.53	47.02	13.20	80.30	93.51
Additional fuel-wood [†]	---	1.50	1.50	---	---	---
Total	320 (100)	819.11	663.68	75.12	80.30	155.43

*Figures in parentheses represent percentage to total

[†]It includes consumption for marriage and death ceremonies

Source: Constructed data obtained from survey

Table-8: Annual Fodder Requirement, Soliya, Gujarat

Sl No	Livestock Type	Number	Requirement Per Day (Kgs)	Annual Requirement (Tonnes)
1	Cows	150	20	1095.00 (06.87)*
2	Bullocks	300	20	2190.00 (13.75)
3	Buffaloes	1125	30	12,318.75 (77.36)
4	Goats	125	7	319.38 (02.05)
Total		1700	--	15,923.13 (100)

* Figures in parentheses are percentage of the total

Source: Based on data obtained from Taluka Development Office, Dediapada and field survey

power. Bullocks, buffaloes and milch cows are stall-fed while non-milching cows and other live-stock population goes for grazing. The grazing areas include reserve forests, jointly managed forests and fallow lands. Some 8-10 % of the total fodder requirement of the village is met through grazing alone.

Bamboo is another NTFP with a great role in the village economy and used chiefly for house construction.

JOINT FOREST MANAGEMENT PROGRAMME

With the formation of GVM, the AKRSP initiated the afforestation programme in the village initially on 17 hectares of revenue wasteland in 1985 by the members of GVM. As time went by, more area was brought under afforestation. By 1992, some 189 hectares were afforested and 86% of this hectareage belonged to the Forest Department (Table-9). Basically, forests in Soliya can be classified into 2 categories

Table-9: Yearwise Afforestation in Soliya under the Joint Forest Management Programme

Year of Planting	Types of Land	Area Planted (ha)	Total No of Saplings Raised Including Casualty Replacement (000)	Total No of Sap-lings Planted Till 1992 (000)	Total No of Plants Surviving March 1991 (000)	Survival Percent-age, etc	Average Height (ft)	Average Girth on March '95 (cm)
1 1985	R	17	94.5	51.00	36.00	85	18	32
2 1986**	R	10	55.5	30.00	21.20	85	17	30
3 1986	F	75	190.0	187.00	220.00	--	18	32
4 1989	F	30	41.4	40.40	24.20	81	5	4
5 1990*	F	30	28.5	28.40	18.11	64	5	4
6 1991	F	27	40.0	39.09	29.34	75	--	--

* Casualty replacement taken up by the Forest Department

** There has been only one year of planting. The plot has quite a substantial proportion of natural plants. Survival counting has been done on the basis of quadrant model.

R Revenue land

F Forest Department land

Source Data supplied by AKRSP and villagers

i) partially planted forests which include roughly 25% natural regeneration and 75% enrichment planting, and

ii) completely or 100% planted forests

Some 30 species are grown in Soliya with pre-domination of bamboo and teak.

CONTROL MECHANISMS ADOPTED BY GVM IN CONSERVATION OF THE NTFP RESOURCES UNDER THE JFM PROGRAMME

The GVM of Soliya has developed a set of rules and regulations to arrange protection for afforested areas. All the male members of GVM protect the forest areas as per the basic principle of labour contribution. Protection in Soliya is done round the clock, throughout the year. Each member gets his turn once in a

month which does not impose too much constraint on the individual's household work. A record of duties is maintained and members are informed when their turns are due. During the agricultural season, when people are busy with their field work, GVM employs 2 watchmen to guard the forests. Protection is required to guard forest property from thefts by members and non-members in the village and persons coming from outside the village. Persons from nearby villages who do not have the JFM programme often steal from Soliya forests. Rules have been framed under the JFM programme to punish theft-offenders. Punishment or fines charged by the GVM Soliya bears a non-governmental approach, i.e., the fines are decided by the GVM members themselves and there is no governmental interference. The fine usually includes confiscation of the stolen forest wood or sticks + fines according to the dimensions of the wood + additional penalty if the offender is a member of the GVM (Table-10)

Table-10: Fines Charged by GVM, Soliya vis-a-vis Forest Department, Gujarat

Items of Theft	Rates of Fine Charges	
	GVM	FD
Members		
Bamboo Stick	Rs 10/stick	Rs 175/stick + 25% surcharge + 25% additional penalty. In addition, the cut-sticks are confiscated
Teak Pole	Rs 25/stick	Rs 3642 per cubic metre of teak wood + 25 % surcharge + 25 % additional penalty. In addition, the cut-poles or teak wood is confiscated
Non-Members		
Bamboo Stick	Rs 20/stick	Rs 350/stick + 25 % surcharge + confiscation of cut sticks
Teak Pole	Rs 50/pole	-do-

Source: Field survey and discussion with Forest Department officials

With the initiative of JFM in Soliya and nearby villages in Bharuch, illegal extraction from the reserve forests was also found to dwindle by more than 50% as revealed by local forest guards. Slowly, the task of protection became easier and simpler with the end of anti-social elements of the village. Villagers, in general, slowly began to subscribe to the idea that stealing would finally nullify the community efforts.

Some 35 participants and other village opinion leaders were interviewed randomly for their reasons in joining or participating in the afforestation programme. They were asked to express their opinion or preference on 1-5 scale, 1 for strong agreement with the statement and 5 for strong disagreement.

The brief characteristics of 35 interviewers for joining the JFM programme may be summarised as.

1) Economic benefits: Three things are important here in this respect

- i) the magnitude of economic benefit,
- ii) timings of these benefits, and
- iii) the expectation horizon in the people's mind.

Further, various economic benefits may be classified into 3 categories: (Table-11)

- a) those that are available instantly or instant benefits,
- b) those that are available within the immediate near future or 3-7 years of plantation, and the
- c) distant benefits which are available after 10 years.

Table-11: People's Expectation about Economic Benefits, Soliya, Gujarat

Particulars	Instant Benefit	Near Future Benefit	Distant Future Benefit
Type of Benefits	Wage employment Availability of timely loan for agricultural input and medical needs	Fuel-wood Fodder Bamboo Commercial* and non-commercial* NTFPs	Timber Fuel-wood
Expectation Horizon	Within 0 to 2 years of the project	Within 3 to 7 years of the project	Beyond 7 to 10 years
Uncertainty involved in the people's mind	Least	More	Most

Source Based on discussion with JFM Participants, Soliya, Gujarat

*Timru, Khakar, leaves, gums, etc

*Berries, fruits, etc, used for supplementary diet

Villagers give high weightage to instant benefits whatever may be their magnitudes. As compared to agriculture, forestry work operations were found to be better paid with increasing rates over the years and this was a strong factor in attracting villagers to join JFM programme in Soliya.

The other instant and second most important economic benefit that people viewed as strong incentive to join JFM programme was the availability of other advantages such as availability of hybrid seeds, finance for medical expenses, etc, from the GVM. The prices charged by GVM were found to be very reasonable and disbursement of agricultural inputs such as seeds, chemicals, and fertilizers very timely

Villagers considered the availability of NTFPs — in particular, fuel-wood and fodder — as the next immediate near future economic benefits. People need fuel-wood and fodder directly to meet out their daily needs. Women of the village were particularly benefitted as now they had easy access to fodder and fuel-wood from jointly managed forests and were saved from the drudgery of

walking miles together to far away places for collection of fuel-wood. This helped in saving on time which could be gainfully employed elsewhere.

Another near-future benefit that people expected to materialize within 3-5 years of JFM plantation was the harvesting of bamboo. Bamboo crop can be harvested from the fourth year since planting and can meet the liquidity needs of the people at large.

The distant economic benefits expected after 30-50 years is in terms of timber, however villagers are a little uncertain about them. The biggest concern to the villagers is the uncertainty of the so-called sharing arrangement between Forest Department and the community in general.

Apart from economic benefits, villagers in general now recognise the ecological and sociological benefits arising out of the JFM programme. In general, people believe that good forest cover brings out good rainfall in the village. Since the commencement of the JFM programme, rainfall was found to increase and water was available even during the summer months, which otherwise was absent. This fact may be sheer coincidence and needs more scientific investigations. Agricultural yield and grass around the fields was found to increase leading to increased fodder supply in the village after the initiation of JFM programme in the village. Village wells were also not found to dry up.

JFM has also brought about a social change in the village in terms of increased interaction among villagers and group dynamics. Provincial and national issues were discussed and people expressed their joint stand or opinions in community get-togethers. JFM was thus instrumental in uniting people to combat against anti-socialism or hooliganism in the village and a culture of solving problems through dialogue and understanding was developed (Table-12).

Table-12: Perceptions of the Sociological Benefits of Joint Forest Management Programme, Sohya, Gujarat

Questions	Scale					Total
	S A	A	U D	D A	S D A	
1 JFM has forged unity among villagers	12	20	2	1	0	35
2 JFM has increased interaction among villagers by breaking caste and gender barriers	7	23	3	2	0	35
3 JFM has inculcated a culture of discussing and solving their problems among themselves	6	20	6	2	1	35
4 JFM has made them politically aware and active	6	21	3	3	3	35

S A Strongly Agree, A Agree, U D Undecided, D A Disagree, S D A Strongly Disagree

Source Based on Survey Results

Visits by officials of the Forest Department / AKRSP promotes participation and protection efforts of the community. In general, people began to feel that other ventures on participation basis can also be started in the village.

MAJOR CONCLUSIONS

1) Forests are an integral part of peoples' life styles in Soliya. Development of forests and its protection in Soliya would surely improve the quality of life of its people.

2) The joint forest management programme as a new institution provides an alternative to regenerate degraded forests and to afforest new areas for fulfilment of various needs of the people such as fodder, fuel-wood, liquidity and other environmental recreational needs.

3) The JFM programme has enhanced the organisational capabilities of the villagers and has brought forth the leadership qualities of individuals. Villagers have developed their own ways to resolve various issues of conflicts. However, the AKRSP has played parental role in developing organisational and leadership qualities among villagers. The real test of the sustainability of the JFM institution lies in the wake of withdrawal of AKRSP's role.

To prevent the crumbling of any institution as such, the AKRSP should withdraw in phases rather than once-for-all withdrawal.

4) Economic benefits from the JFM programme are estimated to be very attractive. Villagers expect a number of benefits from the JFM forests. Of these that they value most are fuel-wood, fodder or grass, bamboo and timber. In the short run, that is during the first 7-10 years of plantation, they harvest grass — valuable output for rearing of livestock. It is estimated that some 20-30% grass requirements of the village is met from JFM forests. Since the 10th year or so of the forests, fuel-wood in the form of fallen and dead twigs become available. Bamboo crop is also ready for harvesting from the fourth year onwards and it brings quite attractive returns to the villagers. Villagers prefer bamboo crop for it gives quick economic return to them. However, timber trees such as teak are preferred by the Forest Department due to the average economic life of teak being about 50 years, while that of bamboo being 25 years.

5) Economics of benefit sharing is the most important factor to determine the sustainability of JFM as an institution per se. Two sets of issues are important in this respect.

- i) sharing of benefits between the Forest Department and village community, and
- ii) sharing of benefits within villagers

The latter issue is an internal issue to villagers and is upto them to decide some functional rule so that everybody is satisfied with the internal sharing arrangement. The former issue is however, open to public debate and is an important one in making the JFM, a financially viable institution.

Management of Community Forestry: A Participative Approach

Jayati Chattopadhyay and Ranjit Chakraborty

INTRODUCTION

From time immemorial, forests have surrendered their productive areas to human beings for settlement and sustenance. Environmental indicators (EI) compiled through Pressure – State Response (PSR) model links the environmental changes with the depletion of forest areas to a great extent. But now it is being increasingly realised that conservation of this valuable natural gift through implementation of different schemes should be taken up in right earnest. Community forestry is considered to be one of the schemes for restoration of balance in nature. It is a departure from classical or conventional forestry as it visualises social objectives.

Community forestry aims at afforestation of all available lands outside the reserve forest areas for the purpose of meeting the requirements of ecological and environmental security, food and fibre, fodder and fuel-wood, socio-economic development of rural poor, preventing soil erosion and adding recreational and aesthetic values to the areas. It is basically forestry 'for the people, by the people and of the people' which has to accomplish 6F's namely food, fodder, fuel, fruit, fibre and fertilizer.

India, after the Rio Summit, is vigorously pursuing community forestry for sustainable economic growth. Flora and Fauna apart, community forestry would provide a resource base for the entire economy. A number of rural and cottage industries like mat and basket making, rope making, lac and tassar, bidi making, preparation of various pharmaceutical drugs and medicines, oils, gums, etc., would have their input resources from community forestry.

In West Bengal, forestry management is a century old concept. In the 50s and 60s mounting demographic pressure compelled to bring an effective change in the prevailing practice which saw a marriage of conservation and commercial forestry. But the gap between the consumption and production level was to be bridged. At such a point of time, the State took up the concept of Community Forestry for implementation with the help of foreign aid as a part of integral development.

The success of a development scheme depends critically on people's participation. Involvement of people too is necessary for forestry development. With

the initiation of community development projects, community participation became a catch word calling for involvement of all the people for all the time.

In West Bengal pro-people land reform measures, initiatives of NGOs, local clubs, youth forum, etc., involvement of people – even school and college students through the three tier Panchayati Raj and planning process from the grass root level blending with an institutionalised pro-people forestry management – all these make the experience of West Bengal unique in the world

Community forestry has been classified by the National Commission of Agriculture into three broad categories – Urban, Rural and Agroforestry.

This paper concentrates on two of these categories, viz., rural and agroforestry on which programmes had been launched in West Bengal. A case study on Strip Plantation, a sub-system of Community Forestry has been presented in this paper with the concomitant Cost-Benefit Analysis and SWOT Analysis. Assessment of people's perception regarding social forestry has also been taken into account.

COMMUNITY FORESTRY SCENARIO IN WEST BENGAL

The forests in West Bengal have a complex and chequered history. During the past century and the early decades of the current one, the forests came under the pressure of extensive agro-economic movement and suffered widespread trespass and disintegration. As a result the Per Capita Forest Area in West Bengal had come down to only 0.02 hectare.

Notwithstanding adverse land-man ratio, conservation strategies have started paying dividends. Satellite images taken in October-November 1988 indicate improvement of the crop, increase in vegetation cover, etc. With the initiation of protective measures, there has been increase in quantity of NTFPs per hectare of forests

Community Forestry in West Bengal is an idea of mid 70s. In this State, Community Forestry is fast emerging as a stable rural institution and a vehicle to achieve rural development through people's participation

West Bengal Social Forestry Project (WBSFP) was launched in the year 1981–82 with a stipulated span of 6 years. The World Bank approved this project for the years 1981 to 1986 with an estimated cost of Rs 348.65 million (US 43.5 million dollar). An IDA credit of US 29 million dollar representing 69% of total project cost was agreed upon. This project was guided by the following objectives of Social Forestry Programme spelt out by National Commission on Agriculture

- i) to provide fuel and thus release cow-dung for manure,
- ii) to help conservation of soil and stop further deterioration of soil fertility,
- iii) to increase production of fruits and some unconventional foods thus adding to potential food resources,

- iv) to provide small poles and timber for house construction, agricultural implements and fencing,
- v) to popularise the planting and tending of trees in farms, villages, municipal and public land for their economic, protective, aesthetic value,
- vi) to increase tree consciousness and love for trees among the people, and
- viii) to create shelter belt around agricultural fields.

Before WBSFP, a pilot project under Arabari Research Range was initiated in 71-72 to protect forest resources by involving people living in the vicinity of forest and to improve their socio-economic position. To motivate people to co-operate in rehabilitating the forest in that area, a series of informal village level meetings were held. 618 families of 11 villages were involved to protect the said area of 1270.92 hectares. They were permitted to collect dry leaves, twigs, branches, grass, poles, for fire-wood, fodder, house building materials, etc., from the forest. An employment scheme was initiated for the members of these families by afforesting blank forest land. Review of the project in 1986 shows the following picture:

Excellent stand of tall cop-	
pice forest of Sal	699.40 Hectare
Fully stocked plantation	486.45 Hectare
Unproductive laterite area	85.07 Hectare
Total cost	Rs 12,10,000/-
Employment opportunity	2.35 lakh man days

Since its initiation, Arabari became the source of inspiration in taking up the Community Forestry Project in West Bengal. Though the West Bengal Social Forestry Project Scheme was scheduled for its completion in 1986, it was seen that physical targets for most of the components have been reached or exceeded but a large portion of the credit remained un-utilised. The World Bank had agreed to extend the project period till December, 1989 and subsequently the period had to be extended upto March, 1992.

To make people's contribution to the developmental effort and decision making in respect of setting goals, formulation of policies, planning and implementing the project, the entire scheme was designed under 4 major components:

Strip Plantation

It envisages establishing plantation alongside roads, canal banks, embankment, river bank, railway track, etc. The villagers are allowed to collect grass, fodder, etc. In the 3rd year after planting, the plantation is handed over to panchayat. Gram Panchayat will select beneficiaries. These people have to contribute greatly towards protection and management of the plantation which would eventually lead to success. Harvesting and sale of final yield will be done

through local DFOs. Cost of creation will be recovered from the revenue and 25% of the rest will be given to the selected beneficiaries. Special fund of Panchayat has been created to accumulate the remaining portion to be utilised in future afforestation work.

Village Woodlot

It is raised on Panchayat land, Government wastland, community tank foreshore, individually owned land dedicated to community school and college compound. Due to the non-availability of panchayat land, lack of interest of panchayats and lack of adequate publicity, this was discontinued in 1989.

Farm Forestry

It is planted on the fallow land, farm band site on vested lands leased to individuals on 'Patra'. Easy availability of land in laterite zone makes this scheme more concentrated in that region. In alluvial zone, homestead lands, embankment of ponds, uplands, etc., were utilised for it.

At many places, people have grouped together to raise farm-forestry and are working like a co-operative. Thus the Farm Forestry movement has turned out to be a group farm-forestry. A farmer has tangible and intangible benefits along with the amount he received through the sale of their product which is unexpected as the type of land is totally unfit for cultivation.

Reforestation of Degraded Forests

It is done either by plantation or by coppicing of degraded areas. In both laterite and alluvial zone, plantation was possible, i.e., it was spread all over the State. Sal forests are managed under the coppice system, which was taken up in Birbhum, Bankura, Burdwan, Midnapur and Purulia. To involve people, specially after 1986, Forest Protection Committees were formed to protect a particular area. The usufructs from RDF are accrued to the local people and preference given to S/C, S/T and economically backward people, provided they assist properly in protection, maintenance and raising of such plants. Local people are permitted to collect 25% of the produce (fuel-wood, fodder, etc.) free of cost.

The physical targets were originally set at a total planting of 93,000 hectare. Later as the period of project was extended by four years, the target had been raised to 1,16,000 hectare. The following table depicts the target of each group along with its achievement.

From the financial year 1992-93, West Bengal Forestry Development Project has been launched. Community Forestry is a part of the entire project.

Community Forestry Project includes

- 1) Model S-I Strip Plantation,

Name of the Schemes	Target	Achievement	Remarks
Strip Plantation	20,000 ha	23,784 ha	Exceeded by 19%
Village Woodlot	6,000 ha	2,405 ha	Less than 50% of the target
Farm Forestry			
Hilly Zone]	75,000 ha	4,999 ha	101% above
Alluvial]		60,670 ha	Target
Laterite Zone]		84,885 ha	
		1,50,554	
Reforestation of Degraded Forests			
Plantation]	15,000 ha	11,926 ha	833% above
Coppice]		53,085 ha	
		65,011 ha	

- ii) Model F-I Farm Forestry, and
iii) Model F-II Forestry Intercropping.

A CASE STUDY IN HOWRAH RANGE OF WEST BENGAL: COST BENEFIT AND SWOT ANALYSIS

Howrah Range consists of four zones namely Howrah, Domjur, Bagnan and Uluberia. Community Forestry has sharply increased from 24 hectares (in 1981) to 80 hectares (in 1993), covering a total area of 680 50 hectares. The aggregated coverage of community forestry in the district is 11884 hectares, which is 8% of the district area.

A Community Forestry, developed in Shyampur No.1 Panchayat Samity area in the district of Howrah in West Bengal was selected for study. From the year 1984, on both sides of road leading to a famous tourist spot Gadiarah, Strip Plantation was made involving local people. Prior to 1984, not much work had been done for replanting and developing this resource. In 1991-92, an assessment of the forest resources created through people's participation was made. The number of trees which have survived and could be used as poles or fuel are given below in tabular forms.

Name of the Species	No. of trees which can be used as poles	No. of trees suitable for fuel	Total No. of trees
Eucalypts	1540	530	2070
Aakashmoni	990	550	1540
Babla	800	1032	1832
Subabul	810	517	1327
Khirtj	25	15	40
Sirish	70	50	120
Total	4235	2694	6929

The number of trees according to size of the pole

Size of the pole	No of trees	Approx market price (Rs)	Revenue earned (Rs)
3"	580	11 00	6,380
4"	200	25 00	5,000
5"	405	36 00	15,390
6"	1,386	60 00	83,160
7"		—	—
8"	670	125 00	83,750
9"	450	150 00	67,500
10"	544	200 00	108,800
Total	4,235		369,980*

The quantity of fire-wood obtainable from various species

Species	Dry fire-wood (in M tonnes)	Dry leaves, twigs, branches, etc (in M tonnes)
Eucalypts	24 575	72 706
Aakashmoni	44 030	47 872
Babla	60 055	63 058
Subabul	99 258	69 333
Khuriy	2 268	2 207
Sirish	2 987	2 000
Arjun	801	500
Total	233 974	257 676

Revenue earned from trees/poles = Rs. 369,980 00 (a)*

Dry fire-wood yields Rs.40 per quintal

Revenue earned from dry fire-wood = $233.97 \times 40 \times 10 = \text{Rs.}93,588 \text{ 00}$ (b)

Branches, twigs, etc yield Rs 10 per quintal

Revenue earned from branches, twigs, etc

$$= 257\,676 \times 10 \times 10 = \text{Rs.}25,767\,60 \text{ (c)}$$

Revenue earned from 6 ha strip plantation = (a) + (b) + (c)

$$= \text{Rs.}489\,335 \text{ 60}$$

At the time of plantation, the total cost (excluding establishment cost and material costs) per hectare was Rs 9,500/-

Therefore, the Forestry Department was able to create a property of Rs 81 56 thousand, just by investing a sum of Rs 9,500/-

Therefore the Benefit Cost Ratio is 9 1

Thus the development of rural economy as envisaged by the planners at macro and micro levels could be materialised through Community Forestry

In this context, it may be mentioned that during 84–85, one person in

Birbhum District could neither meet a square meal per day or other basic needs. But the forestry officials were able to motivate him in Community Forestry. He was assisted in the plantation of 4,000 *Eucalyptus* saplings on his land which he couldn't cultivate due to lack of fertility and hardness (i.e. eroded agricultural land). After meeting all costs and obligations in 1991-92 he had 1 lakh 20 thousand to his credit.

This example of a solitary beneficiary and the previous case study draw out different aspects of Community Forestry in terms of its strengths--- weaknesses – opportunities and threats. The different observable parameters have been indicated in the following matrix:

<i>Strengths</i>	<i>Weaknesses</i>
Labour intensive training	Lack of formal education
Less financial involvement	Absence of co-operatives
Benefits to larger group	Lack of co-operation and dissemination of knowledge and expertise
People orientation	Lack of marketing facilities
Involvement of women and children	Lack of marketing facilities
Arresting soil erosion and environmental degradation	
<i>Opportunities</i>	<i>Threats</i>
Availability of raw materials for cottage industries	Pilferage
Increase in cultivable land	Politicalisation
Changing food habits of rural poor	Emergence of middlemen
Extension of village and khadi industries	Conflicts arising out of distribution of benefits
Generation of surplus for local development	

This analysis has projected the strengths and weaknesses inherent in the prevailing system of Community Forestry and opportunities and threats which would be forthcoming from the external environment. The scheme has to be developed further on the basis of the strengths and devising ways and means to overcome the weaknesses. Opportunities available from the external environment will have to be utilised and threats will have to be contained effectively. A balance sheet if drawn up will show much on the surplus side as is evident from cost benefit analysis. Therefore, it would be possible to look at Community Forestry as an important vehicle for rural development.

CONCLUSION

Management of community forestry has to refocus its objectives to both

psychological and physical well being of the community for whom it exists. The success of the scheme will very much depend on how quickly we are able to involve a greater number of people in the creation, sustenance and management of the scheme. An attitudinal change at all levels has to be developed through training and education and better provision of extension facilities. Community forestry could be a basis for accelerating social changes. An environment of mutual trust, involvement and commitment to achieve the mission – protection and re-creation of benefits for the community and the overall sustainable mass-development – has to be created, maintained and monitored by all concerned

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Women's Role in NTFP Based Enterprises

Alka Shiva

INTRODUCTION

Minor forest products are obtained from forest in bulk quantities to meet the requirement of local people for various needs. In addition many industries are based on them. Some Minor Forest Products also earn considerable amount of foreign exchange from their exports. Women in the villages have to travel long distances for collection of fuel and fodder for daily needs. Therefore, it should, in the first instance be endeavoured to make a selection of such fuelwood and fodder yielding species which may also be a good source of any category of minor forest products. Besides fuel and fodder yielding species there are many plants which are exclusively valued for minor forest products. Plantations of therefore different MFP species will be useful in social forestry programme from which people may derive maximum advantage locally in terms of their daily needs and also for supplementing their income for alleviation of poverty to meet the requirement of food, clothing and shelter.

The following are some of the minor forest product based industries beneficial to man. Fuel-wood and Fodder are also included in the classification of MFP or Non-timber forest products in the modern concept.

- | | |
|--|---|
| I. Agarbatti making | V. Tasar Silk rearing |
| II. Lacquer work | VI. Tendu/Bidi leaf collection,
drying and packaging and
bidi making. |
| III. Myrobalan collection,
drying, grading and
processing | VII. Fruit preservation |
| IV. Soap substitute from Ritha
and Shikakai fruits-collection,
drying and powdering. | |

The role of women in the industries based on such MFP species which are basically useful for fuel and fodder are indicated below while other MFP based industries where women involvement is significant are highlighted later in this paper.

- A. Role of women in industries based on fuel/fodder species

B. Role of women in industries based on plants exclusively of MFP importance

FUEL WOOD YIELDING SPECIES

Today, international aid agencies are receptive to new notions about the purposes and practices of forestry. In essence, they recognize the modern necessity of taking forestry outside the forests — of involving people throughout the countryside in growing trees to meet their own requirements as well as to protect the land on which they and their livestock live

Fire-wood production is particularly appropriate to their philosophy. It is less dependent on silvicultural expertise in comparison to timber for constructional purposes. Therefore, fuel-wood production can be done by non-professionals who may learn the basic techniques for their own use. Trees for fire-wood can be planted in “non-forest” areas along road sides, in shelter-belts, on farms, on unused land, and in school yards, cemeteries, churchyards, parks, and home gardens. Fuel-wood trees can be cultivated in small wood lots, even as individual specimens around a house on village. Fire-wood plantations, if carefully managed and protected from fire, animals, and “poachers” can be self-renewing, they are usually managed on rotations of about 10 years. The timing varies with the quality of the soil, species used, temperature, moisture available, and intensity of cultivation. Rotations of less than five years seem feasible in many areas, especially for those species that regenerate by coppice. Some fuel-wood species which may also be a source of some minor forest products are: *Alanthus integrifolia*, *Alnus nepalensis*, *Casuarina equisetifolia*, *Gmelina arborea*, *Parkinsonia aculeata*, *Pithecellobium dulce*, *Terminalia catappa*. *Trema* species are good fuel-wood species with some subsidiary uses. The following species basically useful for fuel are also known for their MFP importance

Acacia auriculaeformis (Australian Babul)

Besides fuel, this species is used for paper pulp and as ornamental in Bihar, Gujarat, West Bengal, Maharashtra and U.P. Gum can also be obtained from this species

Acacia mearnsii (Black wattle)

It gives excellent fuel-wood and charcoal. Its bark gives very good tannin for making hard leathers for shoes, saddles, etc

Acacia nilotica (Babul or Kikar)

This is considered to be one of the most important species in social forestry

and in farm forestry in dry regions of the country Besides fuel-wood, charcoal and agricultural implements, Babul gives gum arabic which is very much priced as an edible gum. It is also used in printing cloth, paper and in other industries The bark and fruits are used in leather industry. Good quality of honey is also obtainable from Babul flowers.

***Acacia senegal* (Khor)**

Besides fuel, true gum arabic is obtained from this species This gum is very good for many industries, e.g , foods, confectionery, pharmaceutical, printing of paper and cloth, etc. Dried seeds are edible

***Albizia lebbek* (Black Siris)**

This species also gives gum besides fuel-wood and timber It is also planted for shade in gardens and along roadsides

***Anogeissus latifolia* (Dhaora or Bakli)**

Gum, tanning, black dye are obtained from this tree besides timber, fuel-wood and excellent charcoal It is also used for feeding Tassar silk worm

***Azadirachta indica* (Neem)**

All parts of Neem tree are used in the preparation of variety of medicines Its bark is used for tanning. Neem seed oil is used in soaps, medicines, and cosmetics.

***Emblica officinalis* (Amla)**

Used for food, fodder, medicines, tanning and as green manure

***Eucalyptus* spp.**

Very fast growing trees useful for paper pulp and essential oils

***Grevillea robusta* (Silver Oak)**

Besides timber and fuel-wood a very good avenue tree for beautification and shade and a good source of honey

***Leucaena leucocephala* (Subabul)**

Besides fuel, it gives fodder, gum and is useful as a nurse crops

***Pongamia pinnata* (Karnaj)**

Besides fuel, the wood is good timber. Also useful for fodder, fibre, oil, pest control and soil conservation.

***Prosopis* sp. (Vilayti Babul)**

Useful for fuel, fodder, gum and honey.

***Sesbania* sp. (Dhaincha)**

Besides fuel, a good source of pulp wood for paper, food, fodder, gum, tannins, fibre and green manure.

***Ziziphus* spp. (Ber)**

Useful for edible fruits, tanning, fodder, lac and silk host, etc.

FODDER YIELDING SPECIES

Fodder is also an important minor forest produce and women are most associated with fodder collection. Fodder from trees and shrubs is not generally used in India except in forest areas. In north India, grasses become useless with the onset of winter and cattle have to be provided with alternative fodder. In the absence of grass stored up as hay or silage, cattle depend for about six months in the year on leaf fodder, agricultural by-products and green fodder crop. In the central and southern parts of India fodder leaves are being fed to cattle to the extent varying with the availability of grass and agricultural fodder. Almost everywhere, while trees in private lands are left along or lopped systematically, these in avenues, wastelands and forests suffer from ruthless lopping. Therefore some principles for lopping may be regulated to give necessary rest.

These are suggested below:

- i) certain valuable species may be declared as protected from lopping,
- ii) lopping may be stopped in areas liable to erosion,
- iii) saplings and small poles should not be lopped,
- iv) the upper one third of the crown of all trees may be protected from lopping. Branches over 7.5 cm in diameter in the lower two thirds of the crown should not be cut, and
- v) a lopping cycle ensuring complete rest during two growing seasons may be ensured.

In India, fodder from trees and shrubs is ordinarily considered as an inferior fodder to be utilized in times of scarcity, except in some hill tracts where leaf fodder plays a special role in the maintenance of live-stock. Investigations on

the chemical compositions and nutritive value of the leaf fodder of many species found in the country, carried out at the Indian Veterinary Research Institute, Izzatnagar, have given valuable indications. In general, leaves of trees and shrubs are rich in calcium. The phosphorus content is equal to that of the grasses. Observations on the palatability, digestibility co-efficient and nutritive value of the leaves of many trees and shrubs popular in the different states of India have shown that the leaves of 16 species of trees and shrubs constitute a maintenance ration for live-stock.

Following are some fodder yielding species which also are sources of one or more minor forest produce suitable for edible, medicinal products or fibre in which women involvement is significant

Acacia nilotica ssp *indica*, *Acacia catechu*, *Aegle marmelos*, *Bauhinia variegata*, *Dendrocalamus strictus*, *Ficus glomerata*, *Ficus religiosa*, *Helicteres isora*, *Kydia calycina*, *Milletia auriculata*, *Morus australis*, *Ougeinia oojainensis*, *Quercus glauca*, *Q. incana*, *Ziziphus mauritiana* and *Z. nummularia*. Some other important multipurpose species which are lopped for fodder are also given below

Acacia A. modesta, *A. tortilis*, *Acer* sp, *Anogeissus pendula*, *Albizia lebbek*, *Artocarpus chaplasha*, *A. heterophyllus*, *Callicarpa macrophylla*, *Celtis australis*, *Dalbergia latifolia*, *Feronia limonia*, *Ficus* spp, *Grewia* sp, *Hardwickia binata*, *Leucaena leucocephala*, *Madhuca indica*, *Morus alba*, *Quercus* spp, *Schleichera oleosa*

MYROBALANS

Women are closely concerned with collection, drying and grading of Myrobalans. By far the most important of the myrobalans is the fruit of *Terminalia chebula*, known commercially as the Chebulic myrobalans. Two other myrobalans are known in commerce, namely, the Beleric myrobalans from *Terminalia bellirica* and the Emblic myrobalan from *Emblica officinalis*; but neither of these compares favourably with the first named, and when speaking of myrobalans the fruit of *Terminalia chebula* (Harrar) is usually implied. This tree occurs almost throughout India, both in forest areas and outside. Large quantities are collected and sizable quantities are exported. Myrobalans are one of the important tanning materials of the pyrogallol class, a class of tans which produce a brownish coloured deposit on leather called bloom, as opposed to the Catechol class of tans which do not produce this bloom. Myrobalans tan is not very astringent and penetrates the hide slowly. In India, myrobalans are largely used in conjunction with babul, avaram and mangrove barks.

SOAP SUBSTITUTES

A considerable number of plants yield products that contain saponin, a group of

water soluble glucosides. The plant products containing saponins yield a soap froth in water and can, therefore, be used as substitutes for soap. The most important saponin - containing plants are - Ritha and Shukakai. Women play an important role in collection and processing of the fruits of these species.

TASSAR SILK

Production of silk offers opportunities for employment and income generation opportunities at different stages from growing of mulberry trees to rearing of silk worms and harvesting and processing of silk cocoons. Silk is produced by the silk-worm *Bombyx mori* which is fed on mulberry leaves specially cultivated for the purpose in plantations. Other silk-worms which are essentially forest insects are found wild on many plants. The best known of these is *Antheraea daphia* which produces the famous 'tassar' silk of commerce. It occurs wild over the greater part of India, feeding on several plants such as *Anogeissus latifolia*, *Madhuca indica*, *Lagerstromia parviflora*, *Terminalia arjuna*, etc. It is not domesticated but semi-domestication of the silk moth caterpillars is practised in some districts. Eggs or larvae are collected in the forests and placed on trees in plantations or garden where the cocoons can be looked after better with greater ease. Small boys are employed to protect the insects from the attack of birds, and the results of this practice are good. Thus, the tassar silk is obtained from two sources—wild cocoons and cocoons obtained from eggs or larvae on selected trees. The tassar silk worm yields a large compact cocoon of a silver-gray colour. Two or three crops of cocoons are usually obtained each year, and about 12 gm of tassar silk can be got from 15-20 cocoons. Some races of tassar are, however, only one brooded.

TENDU (*DIOSPYROS MELANOXYLON*)

Women have been employed in the bidi leaf trade from the stages of collection, drying and making of Bidis. This enterprise offers immense opportunities to women in employment and income generation. The leaves are used so extensively for wrapping Bidis that the tree is the premier source of Bidi leaves. Leaves from Maharashtra, Madhya Pradesh, Orissa and Uttar Pradesh are considered to be superior to those collected elsewhere for the manufacture of Bidis. The best quality leaves are those plucked just after they have turned from crimson to bright green in colour and are leathery in texture. The leaves should be soft and pliable and should not have an excess of pubescence on the underside or stiffness of primary and secondary veins. Small bushes from root-suckers and coppice-shoots yield the best leaves while leaves from trees are not suitable. The leaves are tied together in bundles of 25-150 and exposed to the sun for 5-10 days. They are turned over frequently until they are fully dried. In

some localities the leaves are dried in the shade prior to final drying in the sun. Bidi leaves are usually packed in the gunny bags for transport. They can be stored for about 2 years.

The leaves in forest regions are sold in auction annually or sometimes, for periods of three to five years so that the purchasers can do pruning or pollarding operations systematically. The revenues derived in our country from Bidi leaves is very significant.

About 80,000 millions Bidis are made annually in India. The industry is located near centres where wrapper leaf is produced. The industry gives employment to 2.5 lakh of people in the collection of leaf and preparation of Bidis.

HONEY AND WAX

The majority of showy flowers produce a sugary substance called 'nectar', which is termed honey. In the gathering of nectar, the bees obtain food and the plant secures the pollination. This symbiotic relationship is one of the most remarkable phenomena in nature. Bees are, however, of less importance for the honey they provide than for their utility as the chief insect agent in effecting plant pollination. It has been estimated that the economic value of bees as pollination is as much as fifty times the value of all wax and honey produced. The individual flower-yield of nectar is so small but it is beyond the practicability of collection by man. Yet, in the aggregate it reaches an immense quantity.

Nectar is composed chiefly of sucrose with some fructose and glucose. It is used as food by the bees and some of it is stored as honey after partial digestion. Honey contains 70-75% inert sugar, together with proteins, mineral salts and water. It has been used as food by man since ages. Besides its consumption as food, honey is used in Indian medicines.

Honey is provided by the wild bees, *Apis dorsata* (the rock bee) and *Apis indica* (Indian bee). The former is wild and is found in montane and sub-montane regions throughout India. It is a good honey-gatherer and a single comb may yield upto 35 kg of honey and 1 kg of wax. The Indian bee is amenable to domestication, but it is not a good-gatherer. The yield per hive ranges from 3-13 kg of honey in the hills and 3-8 kg in the plains.

Bee keeping is a well organized cottage industry in India with an appropriate involvement of women, particularly in the states of Tamil Nadu, Kerala, Karnataka and Maharashtra, with about 40,000 artificial hives. By far the largest quantity of honey, however is collected from natural hives.

Bees wax is used in the manufacture of comb foundation for artificial hives, furniture and floor polishes, dressing and water proofing of leather goods, etc., in which women are also employed at different stages. It is an ingredient of shoe-polishes, cosmetics, lip-sticks, face creams, etc.

OTHER NTFP ENTERPRISES INVOLVING WOMEN

In addition to the above significant NTFP enterprises a few more are mentioned below which involve women although there may be many more. The items indicated below speak regarding the role of women and details have therefore not been given here

- (a) Rope and mat making from bhabar and other grasses
- (b) Bamboo and cane articles manufacture.
- (c) Preservation, pickling and canning of fruits and making of value-added edible products
- (d) Medicinal and aromatic plants enterprises, viz , making ayurvedic drugs, cosmetics, soaps and perfumery items
- (e) Collection of fruits for edible purposes and extraction of fatty oils
- (f) Lacquer works
- (g) Dyeing and printing works from natural dyes.
- (h) Grading and processing of gums

The above MFP enterprises reveal that women can be very suitably employed at various stages for the fulfillment of cottage and small scale industries. The above jobs involve only light labour which women can conveniently handle. It is, therefore, to be seen that women are engaged in an organised manner at different stages. Thus, considerable employment and income can be generated to women who can help in ameliorating the quality of life, thus ensuring adequate socio-economic development.

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Involvement of Women in Sustainable Forest Resource Development

Alka Jain

INTRODUCTION

'Man for the field, woman for hearth' This Victorian concept clearly indicates the limitation put on the role of men and women in the society. Although women constitute practically half the population of the world, their role in sustainable development has been imperceptible. However, of late, the situation is changing for gender equity.

ROLE OF WOMEN

The traditional gender division of labour, made men fit for timber harvesting or construction of house and agricultural implements whereas, gathering/collecting of wide variety of non-timber forest produce (NTFP) for the 'family good' has been entrusted to the lot of women. Trees are very much associated with the lives of women. They are the growers, collectors, head loaders, users and sellers of the NTFPs. They spend more time and labour for the wide variety of forest products and substantiate cash income for the family, who suffer in the absence of women involvement. Shortages caused due to decreased collection of the resources have severe impact on lives of women and their children, who also help their mothers in poverty. Thus, women promote sustainable development because households are managed by women. They are known for their naturally gifted patience and some inborn instincts which help them in tapping locally available resources very skillfully and delicately so as not to harm or damage the other parts of the plant body.

CAPABILITIES OF WOMEN

Women have got the capability to collect small waste wood and twigs for fuel, picking flowers, oil seeds, medicinally important plant parts, separating fibres, tapping gums and resins, making articles with bamboos, canes, making bidi wrappers, leaf plates, collection of lac, rearing silkworms, dyeing and tanning and many other jobs, forming a long list.

However, there is still a lot of scope and need for more advocacy work, more

skill – development, and better communication in order to boost sustainable resource development by women. Some of the problems faced by rural women and the steps required to mitigate them, in order to boost the sustainable forest resource development, have been dealt in this paper.

PROBLEMS FACED BY THE RURAL WOMEN

Although the contribution of women in sustainable forest resource development is quite significant, even then the output does not commensurate with their potential because of the following family, social, economic, cultural and technical constraints:

- i) The rural woman has to bear all the work load of a big family, right from the arrangement of bed tea in the morning till making beds late in the night.
- ii) The main social problem is about the harassment and humiliation faced by the rural women, when collecting the minor forest products. Harassment is created by both forest department staff and their own men. When forest staff create problems, they could at least cry bitterly and expect the sympathy and support of their men. On the other hand, the forest staff talk about the equally strong fear of being accused of molestation by apprehended women (offenders). Now, however, with the village men themselves having taken on policing role, the women's voices have been stifled and the conflict has moved to the home. So, the fear of male dominated society, and its causes are to be overcome from the lives of rural women.
- iii) Economically, the rural woman is very weak. The first priority in their lives is that of management of house. They bear many hardships for the family, sometimes sleeping on an empty stomach due to scarcity of food. Extreme poverty forces the rural woman to survive on a very low budget, leaving hardly any money to buy even necessary tools required for resource generation from the forests.
- iv) Child care is restricted solely to the mother. Women involved in resource development need much more time to collect and process for selling the non-timber forest products. Another problem is that though they share equal division of labour with men, they do not get an equal share of the wages. Besides, they are not involved in any discussion on social or economic problem as in most of the cases they are thought to possess low I.Q., while in truth they may give better idea of the practical problems coming in the way of resource development, and
- v) Although women have the capability to handle the natural resources quite delicately and skillfully, even then, because of being away from the latest

technology, they are not able to utilize their skill to the full potential. In very few cases, they are provided with new techniques, equipments and tools for resource generation.

INPUTS REQUIRED TO STRENGTHEN RURAL FORESTRY WOMEN

To ensure full participation of women, the following inputs would have to be worked out for forestry sector:

- i) Women are the key participants in the forest sector. Their involvement at the grass root levels is massive, but less at professional and technical level. There is a need of their contribution at each level of activity.
- ii) Project strategies and work-plans must be defined, human and financial needs must be identified, so that goals can be achieved. During planning, the women should be allotted certain jobs, in which they can be good participants and beneficiaries.
- iii) In the forest sector certain variables influencing the success of a project are environmental policies, traditional social structure, land tenure and control over the production. These variables are to be considered and studied for involvement of women in NTFPs projects.
- iv) In forest activities most of the women work as labourers, and if so, they are supposed to share more work. It means increased work-load and their exploitation which calls for a balanced role.
- v) Gender differentiated baseline studies and social gender analysis of projects should be practical, participatory, and timely in order to be useful to planners, implementors, monitors and evaluators.
- vi) The women should be given choice according to their tastes so that they can do justice to NTFP collections/harvesting or their value-addition.
- vii) Setting targets for educated women's participation can be a useful way to ensure that women are not deprived of job and training programmes, etc. Promotions and provisions for awarding scholarships will boost women's morale.
- viii) Training opportunities should be created to enable women to acquire technology and skills and thus improve their status and acquire positions with greater decision making capacity. To encourage the women for training programmes, they would have to be educated in the field of science, like nutrition, health care and economics. To get fully involved in the training programmes, they would also need baby sitters for their children, or else cannot involve completely in their work.
- ix) NGOs have the better ability to interact with the people. Women involvement in NGOs can provide technical solutions to social and economic problems, and

- x) Leadership must be provided to women by decision makers to ensure that specific gender ratios are achieved and targets are met for different programmes.

ECONOMIC BENEFIT FOR WOMEN

In this respect, women's right and entitlements have almost been totally overlooked. The distribution of equal rights for women and men in the distribution of income requires careful consideration. However, at village level, the women understand the question and feel that the shares should be divided equally if they have carried the equal work-load. But the tribal and rural women still are unaware of equal rights.

The increased availability of forest produce due to forest regeneration is generally assumed to benefit both women and men. However, preliminary field investigations suggest that reducing the availability of some of the minor forest produce, will reduce the income of women. For example protecting sal trees results in the leaves getting out of reach. This affects the sale of sal leaf plates, which is a common source of income, primarily for poor women. Similarly, tendu leaf, which is also an important source of seasonal cash income for women, tends to decline in a regenerating forest for the simple reason that tendu bushes get shaded out by the growing trees. Tendu bushes also need to be pruned annually for good leaf growth. So each forest management plan has to be considered for the benefit of the women. Each forest management decision implies different costs and benefits with an impact that is likely to vary according to gender. This consideration should be based on more humanitarian and social grounds rather than only to maximize profit. The more benefits should go to the women participants instead of going to middlemen, contractors or the state forest departments as they are the primary collectors of NTFPs.

The snag is that women are seldom consulted or informed about various options and despite incurring disproportionate opportunity costs, they have no clear entitlements even to long-term benefits. They are merely assigned the role of passive executors of decisions and 'educated', 'motivated' and even 'pressurized' to conform for the 'family good'.

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Trees and Climbers to Meet the Primary Health Care Needs

Fr. Sevanand Melookunnel, S.J.

INTRODUCTION

Before modern medicine came to the scene along with the industrial revolution in Europe, people depended upon herbs for their health care needs. In the west, we had the wise women or the witches who had hosts of remedies, which had been tested in years of use. These were the medical persons who took care of the health of the community. Health for all was a reality then because all these wise women as well as the ordinary people knew how to live healthily and in case of ailments they were well acquainted with the herbs to be used.

In India, we have our Ayurvedic system of health care as well as the popular stream of herbal and home remedies. Nearly 60% of our population, especially in rural areas, even today survive mainly by the popular stream of traditional medicines.

However, now the situation has fastly changed and modern medicine has developed its monopoly in health services. Traditional systems of health care, especially home remedies, are being looked down upon as unscientific because they do not measure up to the parameters of modern medicine.

However, using the parameters of modern medicine to judge the validity and effectiveness of traditional systems of health care (which has its own principles and methodologies) is questionable.

For the poor man in our country (over 70% of the population) the modern health care system is inaccessible, because it has become highly commercialised and costly. At the same time, the poor are in a way deprived off of the traditional systems of health care because their resource base, the simple medicinal plants, are not easily available due to the Government's industrially oriented forest policies. First of all, forests are being destroyed by contractors with its detrimental effect on ecology. Secondly, the Government's afforestation (or social forestry) scheme seems to be purely industry-oriented rather than people-oriented. Since they plant single item like *Eucalyptus* on large scale solely for industrial purpose or for timber value alone, with no chance for any other medicinal plant or tree to grow under its plantation. Lastly, whatever natural forests are left, people have no access to them because the Government declared them as reserved forests.

FEW QUESTIONS WORTH ASKING

Forest is a natural resource like land and water and vast number of people depend for their sustenance on them. Who then should have the right to forests? The Government or the industrialists or the people who live by it? Should not the right over natural resources like forests, basically rest with the local community who live by it? Should not all other claims be entertained only after fulfilling the basic needs of these local communities? Should not the principles and uses for outsiders be worked out on the basis of consensus of the local community? In author's opinion, people who live by forests, should not be eliminated for the sake of industrial growth, or foreign exchange or global economy. Poor majority cannot be sacrificed for the comforts of an elite and rich minority.

Since modern medicine is beyond the reach of the poor majority, health for all, cannot be realised unless we resort to the traditional systems — especially the tribal systems of health care. The resource base, which is being destroyed, has to be replenished by planting more trees of medicinal value. About 50 trees and climbers of medicinal value are listed below which could be promoted by the forest department. These should be adopted according to place and climatic condition suitable to them. Only one or two uses are mentioned against each plant, though each of them may be useful for many more ailments.

List of Trees and Climbers That can be Promoted for Primary Health Care

- | | | |
|---|-----------------------------|--|
| 1 | <i>Abrus precatorius.</i> | (Climber) Liquorice; Rati (Hindi), for skin disease (seed paste), Cough (leaves) |
| 2 | <i>Acacia arabica</i> | Babul tree; for Diarrhoea & genital problems (bark) |
| 3 | <i>Acacia catechu.</i> | Black catechu, Khair (Hindi), Dysentery, Haemorrhages (root, bark) |
| 4 | <i>Aegle marmelos.</i> | Bael (Hindi & Eng.), Diabetes (leaf juice), amoebic dysentery (fruit) |
| 5 | <i>Agepetes grandiflora</i> | Agasti (Hindi), Sinus and congestive headache ('natsyam' of leaf juice in nostrils), For all ailments caused by Vit. A deficiency (leaf fried in ghee) |
| 6 | <i>Alangium lamarckii</i> | Akola (Hindi), Dog bite (root), Antidote to any poisonous bites and stings (root paste) |
| 7 | <i>Alstonia scholaris</i> | Dita bark (Eng.), Chatuan (Hindi), Fever, malaria (bark decoction) |

- 8 *Anthocephalus cadamba*: Kadamba (Hindi); Stomatitis, inflammation of eyes (leaf)
- 9 *Anacardium occidentale* Cashew nut, Kaju (Hindi); Skin diseases, especially in leprosy (bark)
- 10 *Aristolochia indica* (Climber), Isormool (Hindi), Snake bite, Whooping cough (leaf & root)
- 11 *Asparagus racemosus* (Climber), Satavar (Hindi); Aphrodisiac, nerve tonic (root powder)
- 12 *Azadirachta indica* Neem (Hindi); Liver problems, skin (bark & leaves)
- 13 *Bauhinia tomentosa*. Kachnar (Hindi), Worm infestation, Dysentery (bark)
- 14 *Bauhinia variegata* Kachnar also Koynar (Hindi), Anti fat remedy, blood in the urine (bark)
- 15 *Berberis aristata* Rasaut (Hindi), Blood purifier, neuralgic pains (root, fruit & bark)
- 16 *Bombax malabaricum* Semal (Hindi), Bleeding piles, Uterine problems (bark)
- 17 *Boswellia glabra* Lobhan (Hindi), Mosquito repellant (leaves), Chronic ulcer (gum)
- 18 *Butea frondosa* Palas (Hindi & Eng.), Worm infestation (seed), Leucorrhoea (bark)
- 19 *Cassia fistula* Golden shower, Amaltas (Hindi), Constipation (pulp), Skin problems (bark)
- 20 *Caesalpinia crista* (Climber), Katkaranj (Hindi), Fever, Malaria (seed) NB Overdose is dangerous
- 21 *Celastrus paniculata* (Climber), Malkangani, Kujur (Hindi), Tuberculosis, Rheumatism (seed oil)
- 22 *Dalbergia sissoo* Rosewood, Shisham (Hindi); Bleeding, Menorrhagia (bark)
- 23 *Embelia ribes* Vidang (Hindi), Worms (fruit), Contraceptive effect (seed powder with pipil and borax)
- 24 *Emblica officinalis* Gooseberry, Amla (Hindi), Eyes, promotes growth of hair (fruit juice)
- 25 *Erythrina indica*. Coral tree, Dadap, Ferud (Hindi), Rheumatism (bark), Painful urination (leaf juice)
- 26 *Eucalyptus globulus*: Eucalyptus, Cough, fever (oil, leaves)
- 27 *Ficus bengalensis* Bannyan tree, Tooth ache (milk); Fracture (aerial root)
- 28 *Ficus religiosa* Pipal tree, Vomitting (bark ashes), Skin diseases (bark)

- 29 *Ficus glomerata*. Fig tree; Gular (Hindi), Diabetes (fruit), Genital problems (fruit & bark)
- 30 *Gymnema sylvestre*: (Climber); Gudmar (Hindi), Diabetes (root & leaves)
- 31 *Helicteres isora*. Screw tree, Maropali (Hindi); Polio, Paralysis (fruit for oil preparation)
- 32 *Holorrhena antidystrica* Kurchi (Hindi & Beng); Chronic dysentery (seed powder)
- 33 *Mangifera indica*. Mango tree, Am (Hindi), Digestive problems (seed powder), Uterine problems (bark decoction)
- 34 *Myristica fragrans* Nutmeg, Jaiphal (Hindi), Insomnia, cough & asthma (seed)
- 35 *Pongamia glabra*: Indian beech, Karang (Hindi), Cough & Bronchitis (seed), Skin problems (bark)
- 36 *Saraca ashoka* Ashoka tree; Female genital problems, Piles (bark)
- 37 *Strychnos nux-vomica* Poison nut, Kuchala (Hindi); Snake bite, nervous diseases (seed purified)
- 38 *Soymda febrifuga* Rohan (Hindi), Uterine problems, fever (bark)
- 39 *Syzygium cumini* Jamun (Hindi); Diabetes, menorrhagia (seed & bark)
- 40 *Tamarindus indica* Tamarind tree, Imlı (Hindi), Insect bite (seed), digestive problems (fruit)
- 41 *Terminalia arjuna* Arjun (Hindi), Heart tonic, Asthma (bark)
- 42 *Terminalia bellirica* Bahera (Hindi), Tannikai (Tam , Mal & Tel), Cough, inflammations (fruit)
- 43 *Terminalia chebula*: Harra (Hindi), Karakai (Tam , Mal & Tel.), Stomach problems, wounds (fruit)
- 44 *Tylophora asthmatica* (Climber); Asthma (leaf)
- 45 *Tinospora cordifolia* (Climber), Amritabali, Gulancha (Hindi), Liver (stem), General tonic (stem)
- 46 *Vitex negundo* Nirgundi, Nochi (Hindi), Pain killer, Rheumatism (leaves)
- 47 *Vitex peduncularis* Charaigoduva, Kakjanga (Santali), Malaria, fever (leaf)
- 48 *Vitis quadrangularis* (Climber) Hadjoda, Sciatica, Fracture (stem)
- 49 *Woodfordia fruticosa* (Shrub) Dhai, Dhathari, Tonic for general weakness (flower) uterine problems (flowers)
- 50 *Cissampelos pariera* (Climber), Patta (Hindi); Internal ulcers (root)

VANISHING SPECIES

There are some species of medicinal plants which are disappearing very fast either because of their indiscriminate use for commercial purposes or destruction of their natural habitat. Some of the vanishing species are recorded below:

- 1 *Celastrus paniculata* (Climber)—Malkangani (T B ,Rheumatism).
- 2 *Soymda febrifuga* Uterine problems, Fever.
- 3 *Rauvolfia serpentina* (Shrub)—Sarpagandi—High B P, Sedative
- 4 *Taxas baccata* (Tree)—Talispatra—Cough and other respiratory problems
- 5 *Aristolochia indica* (Climber)—Isormool—Snake bite, Whooping cough
- 6 *Woodfordia fruticosa* (Shrub) Dhai—Uterine problems,Tonic for general weakness
- 7 *Cissampelos pariera* (Climber)—Patta—Internal ulcers

SUGGESTIONS FOR CONSERVATION

Attempts should be made to conserve these species From CHAI's (Catholic Hospital Association of India) side we try to cultivate few of these like *Aristolochia indica* (Isormool) and *Celastrus paniculata* (Malkangani) CHAI also distribute seeds of these plants to its member institutions which number about 2600 in the country However, CHAI's attempts are very limited as not all the member agencies are involved in it. The Government and the voluntary agencies should also take some steps to conserve and promote these species

In conclusion, the following steps are suggested to promote the growth of medicinal plants especially to conserve the vanishing species:

- i) The forest departments in their afforestation programme can give more emphasis on growing important medicinal plants,
- ii) Gene banks should be established and Government supply seeds to voluntary organisations and others who are interested in promoting the medicinal plants. Emphasis should be given to supply seeds of vanishing and important species of medicinal plants, and
- iii) Tissue culture of the vanishing species could be another step to preserve and promote the vanishing species.

If the forests are not indiscriminately exploited for industrial or commercial purpose and given access to poor people, they will be able to manage their health problems by themselves Health for all, will then become a reality.

Non-timber Forest Products in Nepal: The Potential for Community Management

David M. Edwards and Maksha R. Maharjan

INTRODUCTION

This paper discusses the potential for management of non-timber forest products (NTFPs) by rural communities in the Middle Hills of Nepal. The attempts of the Nepal-UK Community Forestry Project (NUKCFP) to encourage community management of NTFPs are described, using the medicinal plant *Swertia chirayita* (chiraita) as an example.

THE NTFP TRADE

Every year from the Nepal Himalayas, 10 to 15,000 tonnes of NTFPs are harvested from forest land and traded to India. Approximately 100 products are traded. The main markets are the traditional (Ayurvedic) medicine and essential oils industries. Hardly any processing, or even grading, of raw materials occurs in Nepal. Despite this, the annual value of the NTFP trade at the Indian border is estimated to be eight million US dollars (US\$). 80% of this value is distributed throughout rural Nepal as income to a considerable number of harvesters, farmers, porters and village-based traders. In some areas, NTFP collection contributes over 50% of the average household income from all sources (Edwards, in prep.).

CHIRAITA

Chiraita is an erect biennial herb about 1 metre in height. It occurs naturally in open forest and private land at altitudes between 1200 and 3000 metres. There is a stable demand in India for its active ingredient, the drug chiratin, present throughout the entire plant. It is used as a cure for fevers, and as a bitter flavouring for alcoholic drinks.

The total world production is approximately 300 tonnes, the vast majority of which originates from Nepal. Smaller volumes are harvested from neighbouring parts of India. Nearly 50% of total production has traditionally come from the Koshi Hills in east Nepal — one of the two NUKCFP project areas. Between 1991 and 1993, the roadhead price averaged US\$ 2.0 per kg. However, the price

fell recently to US\$ 1 0 per kg (the reason for this is unclear). Chiraita is comparable to the better-known large cardamom (*Amomum subulatum*) in terms of cash value to the rural population of east Nepal (Edwards, 1993, in prep)

FOREST MANAGEMENT IN NEPAL

In 1957, the vast majority of Nepal's forests were declared state property. However, the Nepal Government had insufficient resources to manage forests effectively; they were unable to replace the traditional system of control with its own effective protection and management. People still needed to collect forest products, and thus, despite strict legislation, they broke the law. Many communities continue to practice their informal indigenous management systems, but people have less incentive to gather products sustainably from land over which they have no legal control.

As a consequence, there is a lack of tenure, protection or management of traded NTFPs in Nepal, especially for the high-value products from high altitudes. For many species, this has led to over-exploitation, and harvesting long before maturity. The Nepal Government has banned the export of eight NTFP species, although the effect of this policy on exploitation rates is insignificant.

The problem of forest management was officially recognised in 1978. Since then, the Nepal Government forest policy has put strong emphasis on the management of forests by communities. The current Community Forestry Programme of the Nepal Government was established in 1988, and adopted the concept of Forest User Groups as the most appropriate institution for community management. Discrete areas of national forest are, therefore, being handed over systematically to identified communities which have formed Forest User Groups. These groups have ownership and control over their community forests and may distribute forest products by fixing their prices independently according to an operational plan that they have prepared.

The handing over of available forests to communities will take many years, and the programme has only just begun. It is important that the Forest User Group formation process is not accelerated beyond the capability of the Department of Forests.

NEPAL-UK COMMUNITY FORESTRY PROJECT

A number of bilateral aid projects are supporting the Nepal Government to carry out its Community Forestry Programme. The Nepal-UK Community Forestry Project is operating in two areas — the Koshi Hills in east Nepal and the Dhaulagiri Hills in west Nepal. To date, 585 Forest User Groups have been formed in the project areas. They are responsible for the management of 25,000 hectares — eight per cent of the total forest areas.

The activities of NUKCFP can be divided conceptually into · a) Forest User Group formation, and b) post-formation support.

NTFPs can be managed by Forest User Groups in two ways: i) management of naturally-occurring NTFPs, and ii) cultivation.

Assistance with management of naturally-occurring NTFPs is best given during the early stages of Forest User Group formation (The reason is discussed in the next section.) Assistance with cultivation of NTFPs can come later — as part of a package of post-formation support. These two activities are described in the next two sections.

Community Management of Naturally-Occurring Chiraita

The bulk of the chiraita harvest grows on government forest land that has not yet been handed over to Forest User Groups. Thus, chiraita is officially owned and controlled by the government, but is effectively an open access resource. The consequence is heavy competition to collect the plants. The optimum time to harvest is November or December — after the seeds have ripened and dispersed. However, very little accessible chiraita remains unpicked after September. Chiraita may not be threatened with extinction, but the heavy competition between collectors is certainly reducing its availability.

A few communities have decided to ban chiraita collection in the local area until maturity in November, thus allowing for seed dispersal and better yields in future years. Collection later in the year also substantially increases the immediate yield, because each plant will have grown in size. Grazing may also be controlled. These basic forms of community management can be encouraged in other areas through the Community Forestry Programme. The formation of a Forest User Group for a given forest — and the official hand-over of rights to the forest products it contains — makes protection of the chiraita in the local forest much more likely.

There are two problems with a policy to encourage management of naturally-occurring chiraita through the Community Forestry Programme. These are outlined below.

First, the Community Forestry Programme is oriented towards the provision of fuel-wood, fodder and timber, rather than NTFPs. However, chiraita and many other NTFPs are not just harvested from the local forest, but also from remote locations beyond the boundaries of the community forest, sometimes several days' walk away. Community management of chiraita may require co-operation on a different scale — for a much larger area of land and a different collection of users from a number of communities. Thus, the process of identifying community forests — and the users of those forests — may marginalise NTFPs, and NTFP harvesters. This is made more likely because NTFP

harvesters are often from poorer households with little land — people with less political power to influence community decision-making

Secondly, collection of the traded NTFPs is often during July and August — long before the plants are mature — when agricultural activity is minimal and labour is available. This is also a time when cash is badly needed, chiraita and other NTFPs are sold to local traders before the major festivals of Dasain and Tihar in October. If a decision is made to ban collection until November, this source of income will be postponed until after it is most needed. Thus, access to credit has an important effect on the exploitation of naturally-occurring NTFPs. It can also increase the harvester's bargaining power by reducing their dependence on local traders for cash advances. In the future, Forest User Groups could act as a substitute source of credit.

To conclude, the project can encourage community management of naturally-occurring chiraita through the process of Forest User Group formation. But care is needed to ensure that all the households that harvest chiraita are involved from the start of the formation process.

Cultivation of Chiraita in Community Forests

An increasing number of entrepreneurial farmers in the Koshi Hills have begun to experiment with chiraita cultivation on their private land. Commonly, people transplant immature, one-year-old plants from government forest onto bari land, and thus have tenure over the mature plants during the time of harvesting in the second year. More successful attempts involve broadcasting the seeds in patches of open forest. This can produce considerable yields. In December 1994, one farmer in the Koshi Hills will be harvesting 0.75 tonnes of chiraita from just 0.15 hectares of land. This will be sold at the Basantpur roadhead — five hour's walk away — for the considerable sum of US\$ 800. The potential yield is five tonnes per hectare which would be worth US\$ 5,400 if sold at the current (low) roadhead price. (See also Maharjan, 1994.)

This year, cultivation of chiraita by a Forest User Group took place for the first time. It was a local initiative without project support. The group chose to transplant seedlings from the forest, and consequently the benefits will be modest when compared with the effort involved: they are expecting a total income of US\$ 500. Nine other groups have expressed the intention in their operational plans to cultivate chiraita.

There is an opportunity for the project to support Forest User Groups who wish to cultivate chiraita. A research and extension strategy will be proposed comprising a small number of demonstration plots. The plots will be based on the experiences of local entrepreneurial farmers and aim to demonstrate good cultivation techniques (Maharjan, 1994). The plots will be created in certain

accessible community forests and designed and managed by the Forest User Groups themselves — those that express an interest in chiraita cultivation. They will be useful for a range of activities:

- i) extension through organised visits from other Forest User Groups and community leaders,
- ii) training of project and Department of Forests field staff, and
- iii) action research, providing feedback both to the project and the Forest User Group on the best ways to propagate chiraita in the future.

These activities form part of the post-formation support offered to communities from the project. However, there is one problem with the promotion of chiraita cultivation. This is discussed below.

Nearly fifty per cent of total chiraita production comes from the Koshi Hills. Thus, a major programme of extension among Forest User Groups is likely to increase supply sufficiently to reduce the price in India. The sensitivity of chiraita price to changes in supply and demand is unclear, but the recent 50% fall in price is a cause for concern. If the price falls as a result of cultivation by Forest User Groups, the people most likely to suffer would be the large numbers who are currently harvesting naturally-occurring chiraita in remote rural areas — often people from poorer households with little land. The benefits of the chiraita harvest would be transferred to a minority of relatively prosperous communities near to the influence of the project.

For any extractive product, the transition to a more intensive form of production will often have negative social consequences. These must be understood by the project, and balanced against the need for biodiversity conservation and, more importantly, sustainability of supply.

CONCLUSIONS

The sustainable production of chiraita cannot be achieved through government control. It is best achieved by hill communities, either through management of the naturally-occurring plants (initiated during the Forest User Group formation process), or cultivation in community forests (supported, if necessary, during the post-formation activities of the project).

The potential for community management of chiraita is similar for many NTFPs, including the other high-value medicinal and aromatic plants from high altitudes, for example *Nardostachys jatamansi*, *Aconitum* species, *Picrorhiza kurroa* and *Piper longum*; *Daphne* species for lokta paper production; bamboos and related species, and 'agroforestry crops', for example large cardamom, turmeric and ginger. For all of them, successful management requires a strong sense of community ownership and control.

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Non-timber Forest Products and Management of Homestead Agroforestry in Bangladesh : An Over View

M. Mohiuddin and R.K. Mazumder

INTRODUCTION

Bangladesh is a country of tropical and monsoon climate with rainfall varying from 1200 to 3500 mm. The lands of the country are mostly plain with some hilly areas in the North-East and South-Eastern regions, having a number of valuable natural resources, including both timber and non-timber forest products. Most of the hilly areas belong to government managed forest lands, including both classified (reserved and protected) and unclassified forests. The classified ones, in most cases, are inaccessible, resulting either underutilized or unutilized and the unclassified ones are either denuded or covered by scrubs. Thus the government-managed forestry situation of the country is not in good position. Moreover, government forests are able to provide only less than 15% of the national requirement of timber, fuel-wood, bamboo, etc. On the other hand, forest resources of village groves including both homesteads and privately owned marginal lands provide more than 85% of such national requirements (Douglas, 1982). There are a number of valuable Non-timber Forest Products (NTFPs) commonly available both in government managed forests and village groves of Bangladesh. Various trees, shrubs and herbs of medicinal value are usually grown and often used in Ayurvedic and Unani medicine, particularly by rural people. Besides, some tree species, mostly grown in village groves, also contribute towards the production of some commercially valuable products like Lac, Silk, Catechu, Agar, etc. Bamboo, Rattan, Pati-pata/Murta, etc., provide raw materials for cottage industries. A number of cottage and small scale industries related to these NTFPs also employ a large number of rural people, rural women in particular. Thus, the NTFPs provide considerable economic benefits to the common people of the country.

Clear felling followed by plantation, is the general practice in management and development of government forests of Bangladesh (Anon, 1993). Whereas, management of village grove forests is an integrated approach using a traditional practice of selective harvesting, in association with retention of others. In this case various combinations of species yielding timber, fuel-wood, fruits,

fodder besides species of Non-timber Forest Products (NTFPs), live stocks etc , are involved. In other words, effective utilization of village grove forest resources could reduce the pressure on resources of government managed forests. Therefore, introduction of ideal strategy in the management of village grove forests, homesteads and marginal lands, agroforests in particular, may play a significant role in the conservation and sustainable supply of diversified forest products including non-timber forest products. Management of NTFPs in integrated agroforestry of village homesteads, including marginal lands, could maintain a balanced ecological environment, since collection and processing of NTFPs are often less destructive than other products.

NON-TIMBER FOREST PRODUCTS (NTFPs) OF BANGLADESH

The most common, commercially important, NTFPs in Bangladesh include bamboo, rattan, medicinal plants, pati-pata/murta (natural weaving material), lac, catechu, silk, honey, sungrass, gol-pata, etc. Except sungrass and gol-pata, most of these are often grown in village homesteads and marginal lands throughout the country in addition to the forest lands. These days, NTFPs have acquired due recognition since they provide major economic benefits to common people. The present status of important NTFPs and the programmes for their development in Bangladesh are shown in Table-1.

HOMESTEAD AGROFORESTRY AND NTFPs

Homestead agroforestry, a homestead-mound-based sustainable land use system, combines the production of food (agri-crops, vegetables, fruit trees, live-stocks, poultry etc), fuel-wood, timber, fodder, NTFPs etc. This system is an age-old practice in Bangladesh, which comprises of various species to fulfil the day to day requirement of households. There are around 0.45 million ha of lands under homesteads in Bangladesh, which is about 5% of the total cultivable land of the country (Abdullah, 1986). However, the homesteads and privately owned marginal lands are more reliable than government forest lands, for various forest products in both physical and socio-economic terms.

In physical terms, homesteads and privately owned marginal lands are less vulnerable to overall destruction, including both clear felling and illicit felling and thus are more suitable for raising various species with sustainable production of diversified products. Because these lands are privately owned and usually get more attention than government managed forest lands. There is a general trend in Bangladesh that government property is either a common property or nobodies property and thus either way exploited irregularly or get less attention. In socio-economic terms, around 60% of rural people are landless and most of the landless families still have their own homesteads. Thus the

Table-1: Status of Important NTFPs and the Programmes for their Development

Name of NTFPs	No of spp	Distribution	Uses	Programmes With Cost
Bamboos	18	Government Forest & Marginal Lands, Rural Homesteads & Marginal Lands	Pulp and Paper Industries, Rural & Urban Housing, Community Buildings, Cottage Industries, Baskets & Novelty items	Large Scale Plantation, Increase Production, \$75 00 mil
Rattans	07	Government Forest & Marginal Lands; Village Groves	Weaving in Rural Housing, Cottage Industries (Furniture & Novelty items)	Large Scale Plantation, Increase Production, \$10 00 mil
Medicinal Plants	180	Government Forest & Marginal Lands, Rural Homesteads & Marginal Lands	Ayurvedic & Unani Industries, Rural Medical Practices, Household needs	No programmes but large scale plantation is essential
Pati-pata (Weaving Material)	01	Village Groves, Around Homesteads	Weaving in Rural Housing, Cottage Industries (Floor Mats & Luxury items)	No programmes but organised plantation is essential
Lac Insects	01	Rural Homesteads (Western & North-Western Part)	Shellac Producing Industries, Furniture Varnish	Improvement of Lac insects, Increase plantation of host plants, \$4 50 mil
Catechu	01	In & Around the Agricultural Lands (Western and North-Western Part), Rural Homesteads of other parts (Scanty)	Catechu Production, Dyeing, Medicinal uses	Increase Production, Improvement of processing Industries, \$1 00 mil/
Honey	—	Forests, Sundarbans in particular (Natural), Rural Homesteads (Artificial)	Food, Beverage, Medicine	No programme, Organisation essential

homestead is a fixed asset for poor farmers and obviously plays an important role in their household economy. Moreover, the landless and marginal farmers always try to grow various species in their homesteads in order to meet the needs of their families. The common component species grown in homesteads are usually for food, fodder, fuel, timber, medicine, raw materials of small and cottage industries, etc. Homesteads is also the site for pisciculture, processing of various crafts and cottage industries. Therefore, the homestead is not only the home of the family but also an important production site, especially for the poor farmers. It has been reported that homesteads in Bangladesh provide 80% of wood consumed, 90% of fuel-wood, and 90% of bamboo used (Douglas, 1982).

Although there are large number of species grown in village groves, the

species composition in homesteads agroforests is often determined by the macro-and micro-environment in association with the choice of families according to their needs (Khandaker, 1991). In addition to the ecological reasons, the socio-economic condition of the households is also a major determinant of the species composition in homesteads (Abedin and Quddus, 1990). The common NTFPs of village groves in Bangladesh, particularly in homestead agroforests, are bamboo, rattan, plants of medicinal value including herbs, shrubs and trees, pati-pata/murta, honey, etc. *Ziziphus mauritiana*, *Butea monosperma*, *Litchi chinensis*, *Samanea saman*, etc, are also commonly grown as host plant for lac production. Although, silk and catechu production is concentrated in the villages of northern part of the country, the species of *Acacia catechu* and *Morus* spp (host of silkworm) are sporadically distributed in the village groves all over the country.

MANAGEMENT OF HOMESTEAD AGROFORESTRY

Species composition in homestead agroforestry of Bangladesh is generally diverse in relation to their production. Among these, trees for timber, fuel-wood and fruits, agricultural annuals for vegetables; livestock and poultry for meat and milk, NTFPs for medicine and raw materials of cottage and small-scale industries, etc, are common according to the farmers' needs and experience. Since, homestead agroforestry is traditional and an age-old practice in Bangladesh, farmers invest little in the establishment and management of homestead agroforestry. Farmers always try to incorporate as many component species in their homestead agroforestry practice as possible. Among the components, vegetable crops, trees for fruits and fuel, plants of medicinal value, bamboo, pati-pata, etc, get priority for plantation in the homestead because of their day to day requirement and immediate economic benefits. In most cases, available vacant space rather than appropriate site of homestead is usually considered for plantation. Moreover, the quality of propagating materials for plantation is always beyond the farmers' consideration.

In relation to species composition and spacing between plants, the arrangement of components is not in order, since the economic objectives such as production of wood, fuel-wood, vegetable, NTFPs, etc, have always been taken into consideration for either subsistence or commercial purposes. As a result, in many areas homestead agroforestry is ineffective in maintaining optimum and sustainable supply of various products. However, occasional weeding and cleaning in association with selective annual manuring and pruning of some trees are common practices in homestead agroforestry management of Bangladesh (Abedin and Quddus, 1990). Pruning of trees is generally practiced, as required for fuel-wood, fencing and poles, rather than considering the growth

and productivity of trees. In few cases, farmers prune the trees to increase the sunlight availability in the homesteads.

CONCLUSION

As homestead agroforestry comprises of diversified components in a common production system, harvesting of different products is species specific in temporal sequence resulting in maintenance of sustainable vegetation cover in homesteads. Besides, in most of the NTFP species, only parts of their stand such as stems/leaves/fruits/ older culms, etc., are generally harvested as products. Thus plantation of NTFP species in homestead agroforestry could also maintain sustainability in the production and environmental conservation. Moreover, homestead agroforestry production system is always under day to day observation of households. As a result incorporation of diversified component species in homestead agroforestry, by appropriate arrangement in association with proper management, could induce sustainability in the conservation of resources. Since the development and management of forest resources require a participatory approach as a recent trend, plantation of NTFP species in an integrated management of homestead agroforestry, is appropriate.

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Section 10

VALUE-ADDITION PERSPECTIVES

Effective Utilization of Vegetable Tannins and Dyes in Leather Industry

V.S. Sundara Rao and K.V. Raghavan

VEGETABLE TANNINS

The earliest reported use of plant materials containing polyphenols was in the conversion of animal hides/skins into leather. The polyphenols constitute a distinctive and unique category of higher plant metabolites and form an important class of Non-Wood Forest Produce (NWFP). Their uniqueness lies not only in their relatively large molecular size to suitably orient themselves into a collagen matrix but also in their non-involvement in metabolic pathways, providing energy for growth and reproduction.

Vegetable tannage is probably the oldest of all tannages. Variety of leathers such as sole, belting, kattai and bunwar, saddlery, upholstery, lining, luggage, sports goods, book binding, etc., are produced employing vegetable tannages. The world famous East India tanning process of South India (popularly known as EI tanning) was based on avaram (*Cassia auriculata*) bark, Konnam (*Cassia fistula*) bark and myrobalan (*Terminalia chebula*) nuts. Currently, wattle or mimosa (*Acacia mearnsii*) bark is used predominantly in place of avaram and konnam. The EI leathers are further processed into different types of finished leathers such as glaze kid, suedes, box and willow, gloving, clothing, lining, etc. The leathers that are grouped under East India Leathers are shown in Table-1.

Table-1: EI Finished leathers

Raw Material	Type of Tanning	Finished Leathers
EI Cow Hides	Veg tanned	Linings, upholstery, case and fancy leathers, sports goods and curried uppers
	Combination	Plain and printed shoe uppers, semi-chrome upholstery
EI Buff Hides	Veg tanned	Cheap retanned soles, luggage splits, cheap shoe upper splits
	Combination	Printed leathers
EI Cow Calf	Combination &	
	Veg tanned	Fancy bookbinding, linings, printed leathers, pocket books
EI Buff Calf	Veg tanned	Printed leathers for several uses
EI Sheep Skins	Veg tanned	Linings, fancy, bookbinding, roller skin, hat and printed leathers
	Semi-chrome	Gloves, garments, velvets and gasometer leathers
EI Goat skins	Veg tanned	Fancy, morocco, lining and printed leathers
	Semi-chrome	Suede, glazed kid, garment leathers

* This list is indicative and not exhaustive

Vegetable tanning of hides and skins renders the finished leathers suitable for conversion into consumer articles of natural elegance and touch. The emitted effluents are biodegradable. Vegetable tannins were used in the leather industry as raw plant materials from ancient times till the middle of 19th century. From then on, the tanning extracts, first introduced into the leather industry during 1860-1870, have been used as solid (block) extracts or spray dried powders.

Of the total vegetable tannins produced in the world, 90% are consumed by the leather industry and the rest by others. Of this, 65-70% are used by the heavy leather industry and the rest by the light leather industry. Vegetable tannage of light and heavy leathers require 18-20% and 25-30% tannins respectively. This clearly indicates that the demand for vegetable tanning materials is directly linked with the demand for heavy leathers of which sole leather is the major one which in turn depends on the popularity of leather as a soling material.

However, with the recent awareness regarding the use of ecofriendly materials in leather process industries, the demand is slowly growing for vegetable tanning materials which are environmentally safe products.

The term 'Tan' is said to be derived from the Celtic word for oak and the word 'Tannin' was first introduced by Seguin in 1796 to denote the water extractable matter in certain plant tissues capable of converting animal hide/skin into leather.

The vegetable tannins are water-soluble, polyphenolic compounds having molecular weight in the range of 500-3000 daltons. The low molecular-weight compounds are too small for effective cross-linking and high molecular weight counterparts are either insoluble or too large for cross-linking with oriented polypeptide chains. These tannins, besides participating in the usual phenolic reactions, can impart special properties like ability to precipitate alkaloids, proteins, etc. Since no single constituent of any tanning material with definite molecular weight and structure can be identified as responsible for the (characteristic) tanning property of that particular plant material, the term 'Tannin extract' is used to define the aggregate action of these polyphenolic compounds. Aqueous tannin solutions or infusions known in the trade as 'Tan liquors' are colloidal in nature with a wide range of particle size.

The natural phenolic esters such as those of *p*-coumaric acid and caffeic acid which are invariably mono- and bis- esters of polyols and esters of *o*- and *p*-hydroxy benzoic and protocatechuic acids are less frequently encountered in nature. However, esters of gallic acid ranging from simple mono esters like glucogallin to the complex polygalloylated esters (Gallotannins) occur more readily in nature.

The polygalloylated glucose esters along with proanthocyanidins together constitute the vegetable tannins of commercial and technical importance.

Based on their chemical structures, these vegetable tannins are classified into two types:

- i) **Hydrolysable (*Pyrogallol*) tannins** These are esters of phenol carboxylic acids like gallic acid (*Gallo tannins*) and hexahydroxy diphenic, nanohydroxy triphenic, gallagic, chebolic, terchebolic acids (*Ellagi tannins*) They have the characteristic property of undergoing hydrolysis to form 'sludge/bloom'.

Popular tanning materials like sumach (*Rhus coriaria*, *Rhus typhina*) leaves, dhawa (*Anogeissus latifolia*) leaves, myrobalan (*Terminalia chebula*) nuts, chestnut (*Castanea sativa*) wood, valonia (*Quercus aegilops*) acorn cups and beards, etc., belong to this class of tannins

- ii) **Condensed (*Catechol or Flavonoid*) tannins** Condensed proanthocyanidins based on C₁₅ flavonoids and polyhydroxy flavan 3 O1 - dimers/trimers/and other oligomers belong to this class. They undergo progressive over polymerization/oxidative degradation leading to the formation of 'Tannin Reds/Phlobaphenes'

Commercially, important tanning materials like quebracho (*Schinopsis lorentzii*), wattle (*Acacia mearnsii*), avaram (*Cassia auriculata*), babul (*Acacia arabica*), konnam (*Cassia fistula*), karada (*Cleistanthus collinus*) etc , belong to this group.

Table-2: Further differences between hydrolysable and condensed tannins

Sl No	Hydrolysable	Condensed
1	Produce Sludge / Bloom	Yield Phlobaphenes/Tannin Reds on Standing
2	Less Astringent	Highly Astringent
3	Well buffered	Poorly buffered
4	Small molecules	Large molecules
5	Loss of tannins on storage is more	Loss of tannins on storage is less
6	Leather is lighter in colour	Leather tends to turn red on exposure to light

From leather manufacturing point of view, the condensed tannins are more important as compared to hydrolysable type. Of the total vegetable tannins consumed by the leather industry, 65-70% are condensed type and the rest belong to hydrolysable type

In addition to the above, tannins based on stilbenes have been reported. There are several plant materials containing hydrolysable tannins in one part and condensed type in the other part of the same plant material. Also, there are plant materials which contain the tannin constituents of one type along with the low molecular weight compounds/monomers/precursors, etc , of the other type present together in the same part of the plant material.

The vegetable tannins are also present in almost all the plants in

concentrations varying from trace quantity to as high as 30-35%.

Traces to small quantities of proanthocyanidin dimers (low molecular weight condensed tannins) are present, e.g., in Apple, Strawberries, Blackberries, Coffee, Tea, etc.; Ellagitannin constituents in traces are present in Clove buds; Reasonably good quantities, e.g., Babul (15%), Arecanuts (20%), Cashew testa (25%), Tamarind seed testa (25%), and large amounts, e.g., in Wattle (30-35%), Myrobalan (30-35%), etc

Though the vegetable tannins are present in different parts of the plant, the parts which contain tannins in large quantities are used commercially. This is subject to meeting the commercial requirement of colour of leather. The plant parts used from various plants for their tannins are given below:

Bark: Wattle, Babul, Avaram, Konnam, Sal, Arjuna,

Wood: Quebracho, Oak, Chestnut,

Heartwood: Cutch,

Leaf: Sumach, Dhawa,

Pods: Dividivi, Babul,

Nuts: Myrobalan, Ghatbor,

Root (Tubers): Canaigre,

Galls: Chinese, Turkish,

Acorn cups & Beards: Valonia,

Seeds: Sal seeds,

Husk (testa): Cashew husk, Tamarind husk

Buds: Clove buds, and

Rind: Pomegranate

However, from practical tanning view point, these raw plant materials can be classified into three broad types.

- i) Barks/woods – where the tree is felled for tannin extraction, the quantity and quality of tannins depend on the age of the tree, e.g., mimosa – 7-8 years, babul-6-7 years, avaram-5 years, etc
- ii) Seasonal materials like leaves/nuts/pods including galls – their quality and quantity depends on the appropriate season and proper methods of collection, drying, storage, etc ,
- iii) Byproducts of other industries such as cashew testa, tamarind seed testa, deoiled sal seeds, etc

The exact role played by tannins in the plant material is not yet clearly understood. They are supposed to function as

- i) protective agents due to their astringency,
- ii) toxic agents being phenolic, and
- iii) resistant to frost in temperate zones

The vegetable tannins together with their precursors, low molecular weight compounds and monomers have several properties which are useful in our day-to-day life. These may be categorised as under

i) Medicinal properties

a) The triphala churnam, consisting of a mixture of myrobalan, beheda and amla nuts (all ellagi tannins) is a good ayurvedic medicine,

b) Gum-paint preparations used in the inflammation and soreness of the gums contain gallotannic acid (gallo tannin, tannic acid) to an extent of 25-30%, and

c) The cardiovascular tonic crataegutt, tincture cratagus are based on the dimeric proanthocyanidins of *Crataegus oxycantha*

Recent studies on the toxicity of vegetable tannins towards human skin have clearly shown that human beings are not allergic to tannins of babul, wattle and myrobalans

ii) Other properties

a) taste properties through reactions with the salivary proteins and the glycoproteins present in the mouth,

b) palatability of many fruits that occur on ripening is associated with the concomitant changes in the nature and concentration of tannins present in them,

c) ability to precipitate proteins, and

d) undesirable darkening, due to the formation of higher polymeric quinones by the enzymatic dehydrogenation of polyphenols

Criteria for Material Selection

A number of parameters have to be considered before selecting any plant material for tanning/retanning operations These include

i) sustained availability,

ii) nature of tannins and their molecular weight,

iii) colour,

iv) yield of leathers

Skins	-	minimum	25-30% yield,
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Hides	-	minimum	40% yield,
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v) tannin/non-tannin (T/NT) ratio (see Fig 1)

vi) astringency which controls tanning power, rate of penetration, and buffering capacity of the salts present,

vii) proneness to oxidation, and

viii) acid/salt content

The leaching efficiency cannot be improved by extracting more water soluble matter since it will increase non-tannins, adversely affect T/NT ratio and thereby make the product unsuitable for the given end use

Considering these factors, about 15 tanning materials have been identified

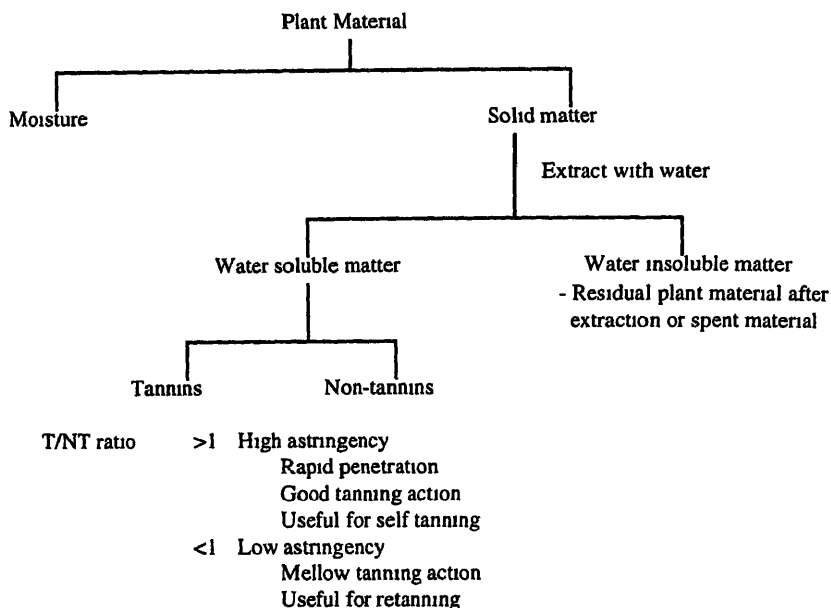


Fig. 1: T/NT Ratio of Tannin Bearing Plant Materials

(Table-3) which are used in the leather industry either as raw plant materials or in the form of solid extracts or spray dried powders with minimum 60% tannin content (on dry basis)

Table-3: Popular Tanning Materials of India

Sl No	Plant Material	Botanical Name	Tans %	Non-tans %
1	Wattle bark	<i>Acacia mearnsu</i> de Wild	35	10
2	Myrobalan nuts	<i>Terminalia chebula</i> Retz	35	15
3	Avaram bark	<i>Cassia auriculata</i> Linn	16	8
4	Babul bark	<i>Acacia nilotica</i> (Linn)	13	11
	Babul pods	Del (syn <i>A arabica</i> Linn)	18	28
5	Konnam bark	<i>Cassia fistula</i> Linn	12	10
6	Ghatbor nuts	<i>Ziziphus xylopyrus</i> Willd	10	15
7	Karada bark	<i>Cleistanthus collinus</i> (Roxb) Benth & Hook	20	12
8	Sal bark,	<i>Shorea robusta</i> Gaertn	8	8
	Sal seeds,		7	11
	Sal seeds-deoiled		10	14
9.	Dhawa leaves	<i>Anogeissus latifolia</i> Wall	15	15
10	Cashew testa	<i>Anacardium occidentale</i> Linn	25	10
11	Tamarind seed testa	<i>Tamarindus indica</i> Linn	20	10
12	Arjun/Kahua bark	<i>Terminalia arjuna</i> (Roxb) Wight & Arn	16	8
13	Cutch extract	<i>Acacia catechu</i> (Linn f) Willd	55	35

Indian Tanning Materials and Their Potential

Globally, about 4 lakh tonnes of vegetable tannin extracts consisting of quebracho, mimosa and chestnut and to a little extent valonia are produced and consumed. Of this, nearly 80% production is accounted for by China, CIS and India.

Indian domestic requirement is estimated as 75,000 tonnes of vegetable tannin extracts. With an increase in demand for more eco-friendly tannages, the demand is likely to go up to 0.12 million tonnes by 2000 AD. As against this, current Indian production is of the order of 9000 tonnes of wattle extract and 8000 tonnes of other extracts like cashew testa, myrobalan, etc. About 15,000 tonnes of wattle extract is being imported annually. The balance of 45,000 tonnes has to be partly met from locally available materials and the rest through additional imports.

Although the tropical and sub-tropical climatic conditions prevailing in India support rich flora, not all the popular vegetable tanning materials that are available in the country meet the required quality and quantities (Table-4).

Table-4: Availability/Potential of Tanning Materials in India

Sl No	Plant Material	Places of Availability	Quantity	Potential
1	Wattle Bark	Tamil Nadu, Karnataka, Uttar Pradesh, Western Ghats Region	42,000 tonnes (Green bark with 50% moisture) in Tamil Nadu)	76,000 tonnes
2	Myrobalan Nuts	Madhya Pradesh, Andhra Pradesh, Orissa, Karnataka, Tamil Nadu, Punjab, Himachal Pradesh	50,000 tonnes estimated	5-10 lakhs tonnes
3	Babul Bark	Tamil Nadu, Andhra Pradesh, Gujarat, Karnataka, Orissa, Bihar, Punjab, Himachal Pradesh	10 Lakh tonnes	NA
4	Avaram Bark	Tamil Nadu, Andhra Pradesh, Karnataka, Rajasthan	3,000 tonnes in Tamil Nadu	7,500 tonnes in Tamil Nadu. Other places not known
5	Cashew Testa	Kerala, Tamil Nadu, Andhra Pradesh, Karnataka, Gujarat	5,000 tonnes (Kerala & TN put together) Other places to be estimated	15,000 tonnes in TN alone, other places to be estimated
6	Konnam	Tamil Nadu, Andhra Pradesh	NA	NA

NA Not Available

Even those available in sufficiently large quantities are associated with some inherent deficiencies as mentioned below:

- i) Hydrolysis of tannins to form sugars - fermentation, mould growth, stinking smell, formation of sludge/bloom and loss of tannins in the case of hydrolysable tannins like myrobalan nuts, dividivi pods, sal seeds, etc.,
- ii) Progressive polymerization and oxidation leading to an increase in insolubles, formation of phlobaphenes/tannin reds, decrease in tannin content, poor penetration, yielding darker colour leathers in the case of condensed tannins like babul, cutch, karada, etc.,
- iii) Extraction difficulties due to the formation of gums and mucilages in the case of ghatbor, swelling of the material, e.g., tamarind seed testa, and
- iv) In the case of timber species like sal, arjun (kahua), the bark could be collected only at the time of felling the tree for timber, by which time the tannins in the bark might have been highly over-polymerized, resulting in the defects mentioned in (ii)

Such deficiencies limit the use of these plant materials in the leather industry. For better, fuller, proper and effective utilisation, they require modifications by physical and chemical methods. The most effective method is to blend them with other tanning materials to counteract the deficiencies of one material with the advantages of other materials. Treatment/mixing with syntans and chemicals is another effective method of modification.

In this context, it is worth understanding the reasons for the fuller utilization of valonea/chestnut, though both belong to hydrolysable type and are likely to be associated with the deficiencies common to hydrolysable tannins as mentioned in (i). The tannin constituents in myrobalan nuts, sal seeds, dividivi pods and valonea, acorn cups/chestnut wood clearly reveal the structural facts that the tannins of myrobalan nuts, sal seeds, dividivi pods are all based on O-glycosides, which are likely to undergo hydrolysis during extraction/tanning process whereas the tannins of valonea/chestnut are based on C-glycosides, which do not undergo hydrolysis during extraction/tanning process.

Tannin Extraction

From ancient times till the middle of 19th century, vegetable tanning was done employing tannin extracts prepared by the tanner *in situ* from raw plant materials which are in the form of barks, wood, fruits, leaves, etc. *In situ* extraction process has certain specific advantages, viz., low cost technology and simple method of extraction. It is amenable for adoption at village level as the tannin bearing plants can be collected from nearby forest areas. However, this method has inherent disadvantages like

- i) high cost of transportation of raw plant materials, particularly those containing less than 10-15% tannins to distant places where tanneries are located,

- ii) low efficiency of extraction leading to dilute liquors,
- iii) energy intensive evaporation process needed for obtaining concentrated extracts, further this facility is not available with most of the rural tanners,
- iv) large space required for storage of raw stock and liquor,
- v) loss of tannins, formation of insolubles and fermentation products, generation of dark coloured compounds, etc., during storage of such liquid extracts, and
- vi) high cost of procurement and storage of raw tanning materials some of which are seasonal, loss of tannin during storage.

Manufacture and marketing of liquid extracts has certain disadvantages. Due to their thermally sensitive nature, they need care during storage and transportation, particularly in the case of tanneries which are located at distant places and are connected by roads in bad conditions. Side reactions like hydrolysis leading to the formation of sludge/bloom, fermentation, loss of tannins, over-polymerization leading to the formation of phlobaphenes/tannin reds, increase in insolubles, etc., are likely to take place during the transport of liquid extracts thereby making the extract useless for self tanning/retanning.

As a result of these disadvantages, the possibility of producing solid tannin extracts from raw materials was explored during 1860-1870, when solid quebracho extract (moisture content 18%) was first introduced into the leather industry in Argentina. Since then, solid extract manufacture has gained importance. The current trend is to manufacture spray dried powder extract with a moisture content of 5-6%. Recent trend is to manufacture extract in the form of granules to avoid dust pollution and thereby avoiding the occupational health hazards.

The advantages of solid/spray dried extracts are:

- i) tanning with extracts takes less time,
- ii) very easy to get concentrated tanning liquors of any strength, thus leading to a quicker and heavier tannage,
- iii) consistency in quality, more so in the case of seasonal materials,
- iv) an extract can be tailored to get a specific product by suitably blending the different materials, and
- v) transportation costs and storage space are less.

However, the possibility of adulteration does exist which can be checked rather easily at raw material stage.

The wide range of vegetable tannin extracts that are now available to the tanners offers many potential benefits to them for producing leathers of highest quality.

The manufacture of the vegetable tanning extract is essentially based on the extraction of tannins from the tanning materials using a suitable solvent, usually water, followed by concentration and spray drying to get powder or

solidification to get solid (block) extract. However, water used for extraction (leaching) should not contain iron and should be soft. The following steps are involved in the process. See also (Fig. 2) :

- i) selection of raw materials,
- ii) size reduction – crushing and grinding,
- iii) leaching (extraction of tannins),
- iv) settling,
- v) filtration,
- vi) concentration (evaporation),
- vii) bleaching,
- viii) drying – Solid (Block) extracts,
– Spray dried powder, and
- ix) Packing.

Generally, plant materials are extracted with any of the following objectives

i) a single constituent extraction – the process is essentially meant for the extraction of that particular compound, e.g., Caffeine from tea,

ii) a group of structurally related compounds, which are extracted and used either as such or after isolation of the required active component from that mixture. The process involves the extraction of such mixture, e.g., Cinchona alkaloids, and

iii) natural formulations consisting of mixture of a group of structurally identical compounds along with biogenetically related compounds and other plant products. This method, essentially involves the extraction of complex mixtures of natural plant products having a specific/potential application, e.g., tannins

Selection of the raw materials should be made on the basis of criteria like tan/non-tannin content, per cent extraction, light colour, etc., mentioned earlier. The raw materials should be free from fungal/insect attack or rotting and should be fresh as far as possible.

Solid and Liquid Wastes

As such the process of extract manufacture does not involve the use of any toxic/hazardous/risky chemicals. Also no inflammable solvents are used. The bleaching agents are used in small quantities (< 1%)

During the process of manufacture of vegetable tannin extract, the following solid/liquid/gaseous wastes are expected.

The only solid waste is spent tanning material (residual plant material after leaching/extraction of tannins). Since this is a natural plant material from which tannins were extracted with water and the plant material has not been subjected to any chemical treatment, the spent material can be used after suitable drying as boiler feed.

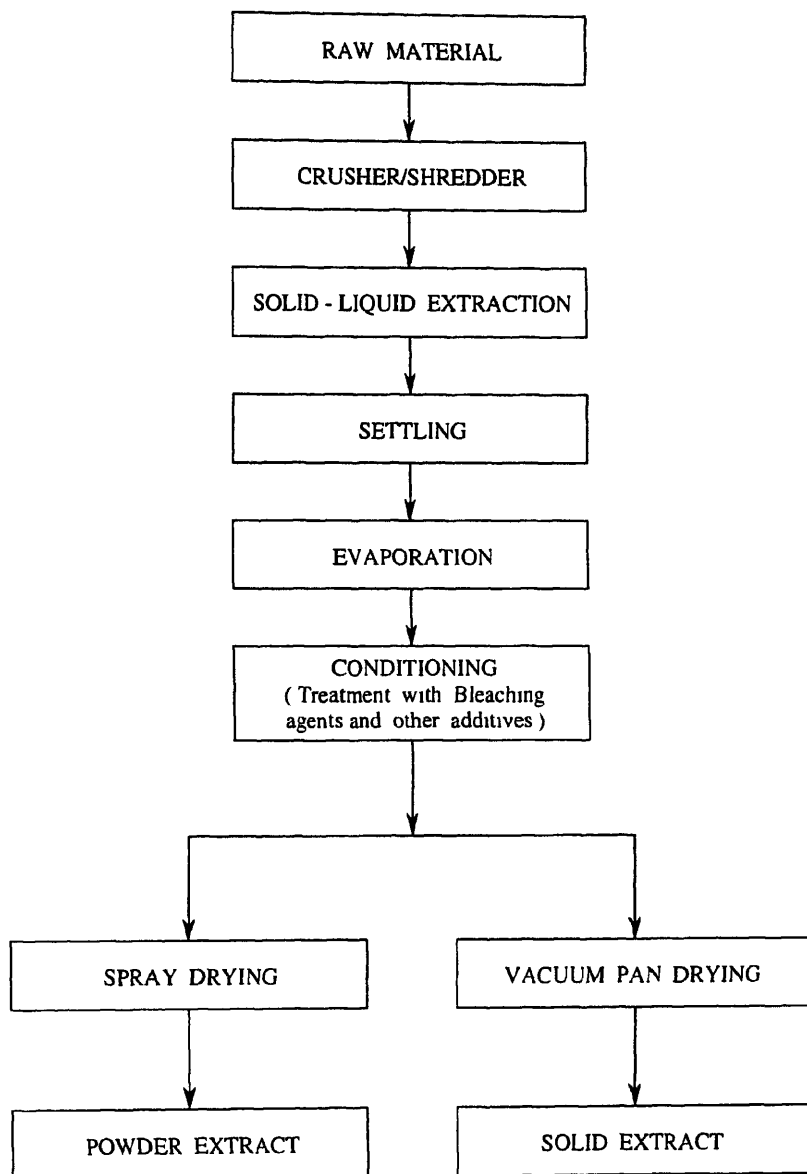


Fig. 2: Process block diagram for the manufacture of vegetable tannin extracts

The extract manufacturing process uses storage tanks and the liquid is transferred through pipes. As such, there is no possibility of any liquid waste except for normal plant spillages and leakages which are not likely to pose any environmental problem in disposal. Since the extract contains valuable tannins, maximum care is taken to avoid any such leakages/spillages.

The gas that is likely to evolve is sulphur dioxide, that too in very small quantities during bleaching operation and this can easily be controlled by using scrubbers and does not pose any environmental problem.

Action plan for Indian Tanning Industry

- i) There is an urgent need to grow more wattle in forest areas in the country where climatic conditions are favourable/suitable.
- ii) Scientific search for plant materials containing compounds other than conventional type of tannins with higher tanning potential, e g , plants containing stilbenes
- iii) Application of tissue culture technique to tannin bearing plants for achieving higher yields and better quality material.
- iv) Grafting techniques for the propagation of tanniferous materials to get the advantages of different tanning materials having both condensed and hydrolysable type
- v) Mutagenic studies leading to an increase in tanning content as well as production of condensed tannins, and
- vi) Search for the effective utilization of alternative plant materials like neem which have multifunctional characteristics

VEGETABLE DYES

Before the mid-19th century, until the discovery of synthetic mauveine by H Perkin in 1856, the only colorants available were dyes of natural (animal/vegetable/geological) origin. The use of these natural dyes over the centuries, especially the middle ages on, laid the foundations of the art and later the science of the modern dye industry.

Dyeing, as the term is generally understood, occurs only when the dye is in solution, usually in aqueous medium. Some dyes, whose solubility is less are called disperse dyes, because they are dispersed rather than dissolved in water. Some colorants called pigments are completely insoluble. The term Colorants is used to describe both dyes and pigments.

By definition a dye is, a colorant that has substantivity for a substrate, either inherent and induced by reactants, and a pigment is a substance in a particular form that is substantially insoluble in a medium but which can be mechanically

dispersed in these mediums to modify its colour and / or light scattering properties

This definition has to be understood clearly as solvent (or fat) soluble, colouring matter which do not appear to conform to the definition as it stands, should be called 'dyes' and may be termed as 'stains'. This is more so in the case of natural dyes which in addition to dyes, contain colouring matter and stains which do not have any dyeing properties on fabrics. Many natural dyes are mixtures of two or more colouring matter

By definition, the natural dyes and pigments comprise all those that are obtained from vegetable/animal kingdom with no or very little chemical processing. Although most of the natural dyes have very little commercial significance, their use has not totally disappeared from the market. The handicrafts worker believes that nature knows the best. The handicraft industry is a major employer of natural dyes in India.

Though the use of natural colorants for textiles and fibres has declined, their use for colouring foods and ingested products has recently increased. This has been prompted, in part, by the Government regulations, environmental consciousness, concern regarding the carcinogenicity and mutagenicity of synthetic dyes.

Sources of Natural Dyes

As already mentioned most of the natural dyes in use are of plant origin (hence the term 'Vegetable dye' is used in this paper). The sources of natural dyes include .

- i) plant kingdom – e.g , indigo, logwood, fustic, etc ,
- ii) animals and insects – e.g , lac, cochineal, carminic, etc ,
- iii) Marine (shell fish) – e.g , tyrian (royal) purple, etc., and
- iv) earth crust (mineral) – e.g , chromates, iron oxide, coal etc

Occurrence

The Vegetable dyes occur in almost all parts of the plants. Perhaps, in any plant materials, the dyes are concentrated in a particular part only. That part is used commercially of course, after considering other factors like the chemical structure of the dyes and their reactivity with the substrate concerned, the shade, intensity and light fastness, wash fastness, penetrating properties wherever required, etc. The part used commercially of different plants is listed below:

Flowers, e.g , safflower, toon, bengal kino, Fruits/pods, e.g , kamela, Berries, e.g , black berries, Seeds, e.g , annato; Nuts, e.g , myrobalan, Bark, e.g , quercus spp , Leaves, e.g , henna, indigo plant, Roots, e.g , maddar, Heart wood, e.g , red sanders, Wood, e.g , logwood, sappan wood, and Fruit rind, e.g pomegranate

Structure and Classification of Dyes

There may be several methods of classification like, e.g., the classification based on the part of the plant, based on the colour, etc., but the scientific method is based on the chemical structure of the dyes. Structurally, the dyes are classified in to :

- i) Polyene Dyes based on isoprene unit, e.g , carotenoids,
- ii) Quinonoid dyes· based on 1, 4 - naphthaquinone and 9, 10 - anthraquinone,
- iii) Flavonoid dyes: based on chalcones, flavones, flavans, aurones, anthocyanins, isoflavones, etc. Structurally, this group of dyes are related to and commonly occur in condensed type vegetable tannins. The famous phenomenon - 'Tannin Reds', the red colour associated with condensed tannins - either as such or with the leather tanned with condensed tannins, is mainly due to this class of dyes which are mainly anthocyanidins,
- iv) Dihydropyran dyes. e.g., logwood, sappan wood, brazil wood. This group of dyes is one of the most important and was used in leather industry. As already mentioned, still logwood retains its commercial importance,
- v) Diarylmethane dyes· e.g. turmeric,
- vi) Indigo dyes. based on 3-hydroxy indole (Indoxyl), e.g , Indigo, Tyrian (Royal) purple and berberine (the only basic dye of natural occurrence) and
- vii) Porphyrin dyes· based on pyrrole, e.g , chlorophyll, haem, etc.

In addition to these, there are several other colouring matters present in plant materials. These include purines, isoalloxazines, phenoxazines, melanins, betalains, etc. However, their dyeing properties on a particular substrate have to be studied in detail.

Advantages of Vegetable Dyes

- i) harmonising colours,
- ii) possibility of rare colour ideas,
- iii) more challenges due to element of chance (quite often the natural dyes are mixtures of more than one dye constituent), and
- iv) minimum pollution problems - most eco-friendly, environmentally safe, green, healthy, etc.

Constraints

As against these advantages, there are some constraints which may be considered important. These include:

- i) non-sustained availability of dye from plant material, and the likelihood of ecological damage due to unplanned felling of the flora,
- ii) technology for the extraction of dyes yet to be perfected,
- iii) availability of limited shades and colours,
- iv) unfavourable cost factor as compared to synthetic dyes,
- v) unsatisfactory fastness properties to light, washing, etc.,
- vi) require mordants for dyeing, and
- vii) quality and quantity (yield) depend on method and timing of harvesting/collection.

Dye Yielding Plants of India

There are several dye yielding plants available in the country. Most of the plants are useful for cotton / wool / silk. These are listed below.

- | | | |
|-------|---|--|
| i) | Khair/Cutch
(<i>Acacia catechu</i> heart wood) | flavonoids - condensed tannins
CI Natural Brown 3
CI 75250 |
| ii) | Annatto
(<i>Bixa orellana</i> seeds) | Polyene - Bixin
CI Natural Orange 4
CI 75120 |
| iii) | Sappan
(<i>Caesalpinia sappan</i> wood) | Dihydroxyphenyl - Brazilin
CI Natural Red 24
CI 75280 |
| iv) | Safflower (Kusum)
(<i>Carthamus tinctorius</i>
florets) | Flavonoids - chalcones
CI Natural Red 26
CI 75140 |
| v) | Indigo
(<i>Indigofera tinctoria</i> leaves) | N-heterocyclics - Indigo
CI Natural Blue I
CI 75780 |
| vi) | Henna
(<i>Lawsonia inermis</i>
(<i>L. alba</i>), leaves) | Naphthaquinone - Lawsone
CI Natural orange 6
CI 75480 |
| vii) | Indian Mulberry
(<i>Morinda citrifolia</i> root bark) | Anthraquinone - Morindone
CI Natural Red 18
CI 75380, CI 75390 |
| viii) | Kamela
(<i>Mallotus philippensis</i>) | Flavonoids - Chalcones
CI Natural Orange 2
CI 75310 |

ix)	<i>Myrica nagi</i> (<i>M. esculanta</i>), bark	Flavonoids - flavonol
x)	Indian Maddar (Manjith) (<i>Rubia cardifolia</i> roots)	Anthraquinone - Purpurin, Manjistin, CI Natural Red 16,
xi)	Indian Mahaganı (Toon) (<i>Cedrela toona</i> flowers)	Polyene - Nycanthin CI Natural Red 1 CI 75100
xii)	Red sanders (<i>Pterocarpus santalinus</i> wood)	Naphthaquinone - Santaline CI, Natural Red 22 CI 76540
xiii)	Pitti (<i>Ventilago madraspatana</i> root bark)	Anthraquinone CI Natural Orange 1

General Methods of Preparation

The general methods for the preparation of these plant dyes can be divided into

- i) Physical methods like - beating / shaking the raw material, e.g., kamela,
- ii) Extraction with water
 - a) as such, e.g., henna, kamala, Indian mahogany,
 - b) as such followed by concentration, e.g., cutch, logwood,
 - c) as such followed by fermentation, e.g., sappan wood,
 - d) as such followed by fermentation and oxidation, e.g., indigo,
- iii) Extraction with acidulated water
 - a) as such e.g., Indian mulberry
 - b) the residual plant material reextracted with aqueous sodium carbonate followed by acidification, e.g., safflower, and
- iv) extraction with aqueous sodium carbonate solution followed by acidification and coagulation with NaCl, e.g., annato

Leather Dyes from Vegetable Sources

Leather manufacturing involves the use of several chemicals/auxiliaries/ formulations during the process of converting the raw materials - hides and skins into finished leather. These chemicals are generally classified into i) general purpose chemicals, ii) basic tanning agents, and iii) tailor made speciality performance chemicals which are meant for specific end use. These performance chemicals are further sub-divided into.

a) wet processing chemicals like dyes, fat liquors, etc., and b) finishing agents like pigments, top coats, etc.

With the growing awareness to protect environment, there is now a tendency in all processing industries to i) use environmentally safe and eco-friendly chemicals/auxiliaries/formulations, and ii) avoid/eliminate environmentally

sensitive chemicals which are toxic/hazardous. This can be achieved by several ways and one such method is to use natural materials as far as possible. In leather manufacturing process quite a good number of natural products are used. These include, natural tannins, vegetable dyes, oils/fats, protein binders, natural preservatives, etc.

Leather is a high value commodity in the International trade and commerce and is dyed with a mixture of dyes to get the desired shades and intensities to cater to aesthetic aspects and competitive market.

Leather differs from textile materials due to its reactive 3-dimensional structure. Chemically, leather is very close to silk and wool and consequently natural dyes useful for silk and wool may be screened for use in leather, of course keeping in view the 3-dimensional structure of leather where penetration plays a greater role.

The chemical reactivity of collagen, the main fibrous protein of hides and skins is modified by various physical and chemical treatments during pretanning and tanning operations of leather manufacturing process. During these processes the raw materials are subjected to different pH conditions, both on the acidic and alkaline sides. These chemical treatments and the resulting pH conditions result in the modification of the reactivity and surface charge of collagen (Fig. 3).

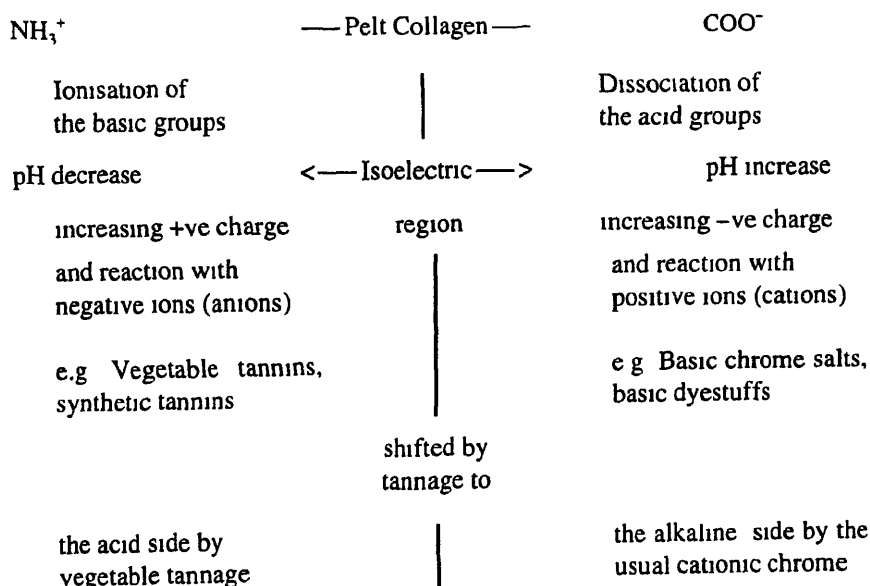


Fig. 3: Surface charge characteristics of leather

Leather dyeing has to be implemented on a system consisting of collagen tanning agents - water molecules present in the fibre pores. Leather dyeing with natural dyes has an advantage in that the incorporated tannins (mineral or vegetable) act as mordants for the natural dyes.

The special/additional advantages of vegetable dyes in leather processing are

- i) both flesh and grain sides can be dyed with same shade,
- ii) a more level shade is produced,
- iii) grain defects are not emphasized,
- iv) full handle is imparted to mineral tanned leathers,
- v) grease dispensing effect is exerted,
- vi) buffing properties of suede and nubuck leathers are improved,
- vii) eco-friendly/environmentally safe, and
- viii) biodegradability

The most important leather dyes include (i) logwood (*Haematoxylon campechianum*), (ii) fustic (*Chlorophora tinctoria*), (iii) osage orange (*Maclura pomifera*), (iv) oak (*Quercus tinctoria*) bark, (v) hypernic, etc. All of them require different mordants for achieving different colours.

The dye-yielding plants highlighted earlier, are not native to India. There is a need to look for indigenous dye-yielding plants. While screening natural dyes for their use in leather manufacture, the following criteria should be kept in mind:

- i) the chemical reactivity and surface charge characteristics of leather (Fig. 3), as well as 3-dimensional net work,
- ii) the shades required:
 - a) fast moving shades: Black, brown (light / medium / dark), grey, fawn,
 - b) fashion shades: Light / golden yellow, light blue, green, pink, red,
- iii) methods of application, penetration properties, fastness properties to light, washing, etc.,
- iv) the strikers required and their eco-friendliness,
- v) Other aspects like availability of dye-yielding plants, and methods of preparation, cost, etc.

Future Prospects

- i) Biotech/tissue culture techniques to improve the yield of colourants and a wide range of colours from plants.
- ii) Technology for the extraction of colourants to market dyes in a ready-to-use powder form, and
- iii) New research efforts on the chemical modification of readily available natural dyes to obtain better shades and intensities on leather.

Chemistry of *Diospyros melanoxylon* (Kendu) and Search for Alternative Uses of Kendu Leaves

Anita Panda, Madhumita Padhy, Reeta Misra,
U.V.M. Avadhani and Y.R. Rao

INTRODUCTION

The species *Diospyros melanoxylon*, locally known as kendu is distributed in the Indian peninsula extending into Orissa, Bihar, Madhya Pradesh, Maharashtra and Andhra Pradesh. The potential yield of kendu leaf in different states is given below in Table-1.

Table-1

State	Potential yield in lakh quintals	Present collection in lakh quintals
Orissa	10	4 - 5
M P	20	10
A P		1

It is reported to be of importance for afforestation purposes. The leaves are highly esteemed for wrapping bidis. Their flavour, flexibility, and resistance to decay are the properties, which are particularly valued for this use. Thus, the kendu leaf trade is an important socio-economic activity and is a good revenue earner for the government.

An estimated 5 lakh quintals of kendu leaf is collected from Orissa forests and processed every year. During the processing, about 15-20 % leaf of 25 crores worth is rejected. It is known that kendu leaf remains unaffected on storage suggesting some inherent insecticidal/fungicidal properties inherent in the leaf.

In order to utilise the full potential yield of kendu leaves and the waste generated during the processing, it is desirable to examine alternative uses for this vast forest renewable resource.

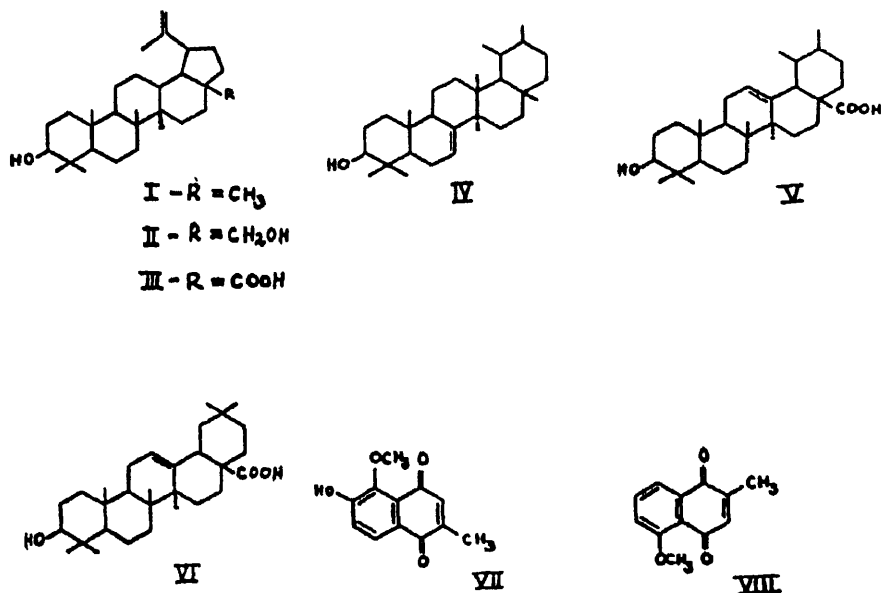
The leaves reportedly contain some plant pigments like carotenoids, chlorophyll A and B, tannins, triterpenes and steroids, etc. Thus, study of chemistry of kendu leaf (*Diospyros melanoxylon*), identification of major and minor compounds present and their utilisation for value-added products of commercial

importance, biological screening of extracts for possible pesticidal/insecticidal activity is essential

CHEMICAL EXAMINATION OF *DIOSPYROS MELANOXYLON*

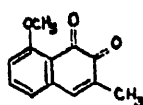
Gupta *et al* (1964) reported the presence of Lupeol (I), Betulin (II), and a monohydroxy carboxylic acid designated as diospyric acid and a new triterpene alcohol. Rao, *et al* (1964, 1966 & 1969), re-examined the same leaf and identified the new alcohol as Bauerenol (IV). They also obtained (I) and (II). Three triterpene acids were obtained from the ethanolic extract, which was fractionated into an ether soluble fraction. The acids obtained by chromatography, chemical conversion and fractional crystallisation were identified as Betulinic acid (III), Ursolic acid (V) and Oleanolic acid (VI). From the physical data, diospyric acid of Gupta *et al.* (1964) was identified as Ursolic acid.

Gupta *et al.* (1964) has isolated ceryl alcohol and β -sitosterol other than the triterpenes. Chowdhury (1973) fractionated petroleum ether extract with 70% ethanol and from the petroleum ether fraction isolated by column chromatography hentriacontane, hentriacontanol and α -amyrin

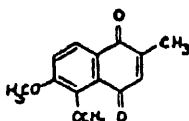


Sankaram and Sidhu (1964) examined the bark and sap wood of *D. melanoxylon*. From the petroleum ether extract betulinic acid and another unidentified acid were isolated from the alkali soluble portion. Lupeol, betulin and β -sitosterol were isolated from bark and sap wood respectively from the neutral portion. A water soluble orange 2-methyl-5-methoxy-6-hydroxy-1,4-naphthoquinone (VII) (Sidhu & Sankaram 1966) was obtained from the chloroform extract of the heart wood on chromatographic separation under nitrogen atmosphere

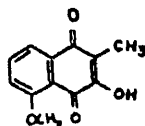
2-Methyl-5-methoxy-1,4-naphthoquinone (VIII) and 3-methyl-8-methoxy-1,2-naphthoquinone (IX) along with 2-methyl-5,6-dimethoxy-1,4-naphthoquinone (X) and 2-methyl-3-hydroxy-5-methoxy-1,4-naphthoquinone (XI) were obtained on further examination (Sidhu *et al.*, 1968) of the heart wood. 3-methyl-1, 8-dimethoxy-naphthalene (XII), 3-methyl-4,8-dimethoxy-1-naphthol (XIII) and 3-methyl-8-methoxy-1-naphthol (XIV) are the new naphthalene derivatives isolated



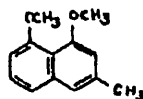
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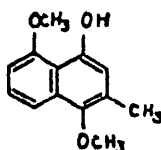
X



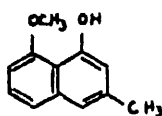
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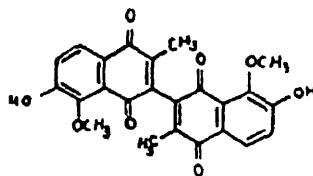
XII



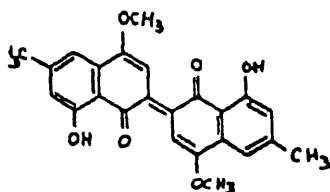
XIII



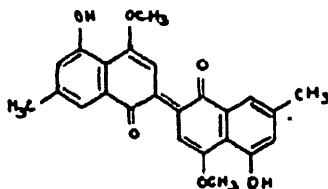
XIV



XV



XVI

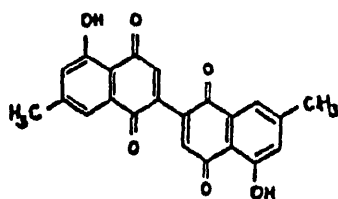


XVII

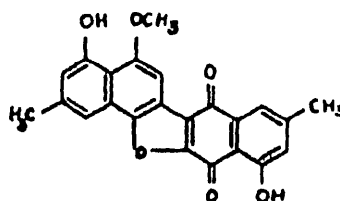
Besides, a new binaphthoquinone identified as 3,3'-dimer of 6-hydroxy-5-methoxy-2-methyl naphthoquinone (XV) was also isolated (Sidhu *et al.*, 1973)

Sankaram, *et al.* (1981) have further isolated from the heart wood, the phenolic pigments Diosindigo A (XVI), Diosindigo B (XVII), Biramentacenone (XVIII) and a new pentacyclic quinone (XIX). Irradiation of Diosindigo B with sunlight gave the new compound and Biramentacenone.

Inhibition of germination of seeds of *D. melanoxylon* was studied (Mishra 1980) and the presence of phenols in the seed coat was found to be responsible for the endogenous inhibition. The fatty acid composition of the seed oil of



XVIII



XIX

D. melanoxylon was determined and found to be lauric 4.6, myristic 9.9, palmitic 37.9, stearic 16.1, arachidic 5.3, behenic 5.3, oleic 19.7 and linoleic 1.2 by Vij, *et al.* (1981)

PROXIMATE ANALYSIS OF NORMAL FRESH KENDU LEAF

Some kendu leaf supplied by Forest Department were found to be infested with fungus. It is also known that kendu leaf is attacked by fly, *Triozaboleta buckton* (Homoptera: Psyllidae), which causes blisters on the leaf. The leaf examined was thus graded into 3 categories — normal, blister and fungal infested.

The leaves have been analysed for moisture content, protein, water soluble extractives, crude fibre and ash and the results are given in Table-2.

Table-2

		Kendu leaves		
		Normal	Blister	Fungal infested
1	Moisture content	11.0	10.8	11.2
2	Protein*	6.5	6.8	7.1
3	Water soluble	16.8	17.1	16.5
4	Crude fibre	53-55	53-55	53-55
5	Ash	6.5-6.8	6.3-6.5	6.5

* Based on Kjeldahl nitrogen

SYSTEMATIC CHEMICAL EXAMINATION

For identifying different chemical constituents, the leaf was powdered and exhaustively extracted successively with hexane, ethyl acetate and methyl alcohol. Removal of solvent from these extracts provided syrupy residues which were subjected to chromatographic separation and chemical identification.

In the following Table-3 are given the data on the extraction of normal kendu leaves with three solvents

Table 3: Extractives of normal kendu leaves Amount used for extraction 1.8 kgs kendu leaves

Solvent	Amount in gms	Physical appearance	Percentage
Hexane	30	dark green semi-solid	1.67
Ethyl acetate	128	---- do -----	7.12
Methanol	317.1	dark red semi-solid	17.6

These extracts were tested for larvicidal properties and larval mortality was not found with any of the tested extracts. Further studies on antifeedent and ovicidal properties are in progress.

COMPOUNDS ISOLATED FROM HEXANE EXTRACT

The hexane extract (10 gms) was chromatographed over silica gel using hexane, and the eluent gave only the fatty material and was not further studied.

The fractions obtained from 2% ethyl acetate/hexane were evaporated and the residue was crystallised from hexane; m.p. 88.1°C. The compound was identified as 1-hentriacontanol from IR data, m.p. and literature data.

On further elution with 4% ethyl acetate/hexane a crystalline solid was obtained. It was crystallised from ethanol, m.p. 140°C. The compound was identified as β -sitosterol by preparation of acetate (m.p. 128-9°C) and IR data. It gave positive Libermann-Burchard reaction.

Elution of the column with 15% ethyl acetate/hexane gave a mixture of two compounds. The mixture was rechromatographed over Alumina. The Alumina column was eluted with 5% ethyl acetate/hexane and two compounds were separated. These compounds seem to be different from what are reported in the literature and are under spectral investigation.

COMPOUNDS ISOLATED FROM ETHYL ACETATE EXTRACT

The ethyl acetate extract (128 gms) on treatment with ether gave ether soluble (63.01 gms) and insoluble portion. The ether insoluble fraction on treatment with chloroform resulted chloroform soluble and insoluble portion. The chloroform and ether solubles were combined, put on TLC, which showed some prominent spots and hence column chromatographed. The chloroform

insolubles on extraction with hot methanol followed by cooling to room temperature gave a greenish brown solid and methanol soluble fraction.

The alcohol insoluble fraction was column chromatographed over silica gel using chloroform, 1 and 2% (MeOH/CHCl₃) successively as eluents. Two triterpenoid acids were isolated. The fractions were evaporated and the residue (1.9 gms) was crystallised from methanol; m.p. 259°C. Another compound was also isolated in minor quantity (42 gms); m.p. 240°C. These compounds are at different stages of identification.

BIOACTIVITIES OF COMPOUNDS ISOLATED FROM *DIOSPYROS MELANOXYLON*

Ursolic acid and α -amyrin have been found to have anti-cancer and anti-tumor activity (Mahato *et al.*, 1992). Ursolic acid showed significant cytotoxicity in the lymphocytic leukemia cells P-388 and L-1210 as well as the human lung Carcinoma cell A-549. It also has marginal cytotoxicity in the KB and human colon (HCT-8) and mammary (MCF-7) tumor cells.

Lupeol, betulin and betulinic acid have been known to be cytotoxic and possess anti-neoplastic activity (Sukh Dev *et al.*, 1989) against Walker Carcinoma-256. Some of the quinonoid pigments isolated from other *Diospyros* species such as 7-methyl juglone, diospyrin and isodiospyrin have been shown to be active against HCT-colon tumor and P-388 Carcinoma (Carter *et al.*, 1978). Diospyrin has activity against Protozoa *L. Donavani* in which complete inhibition was observed (Yan *et al.*, 1989) at a concentration of 1 μ g/ml.

Oleanolic acid derivatives and oleanane-type triterpenoids showed remarkable suppressive effects (Mahato *et al.*, 1992) against the tumor promotor. In particular, 18-oleanane derivatives having a -CH₂OH group at C-17 were found to be 100-fold more effective than glyoxyrrhetic acid. Oleanane type triterpenoids (-diol) showed anti-ulcer, anti-inflammatory and anti-allergic activities in rats without side effects. Oleanolic acid was effective in the prevention of experimental liver injury induced by injection of CCl₄ in rats.

Similar to triacontanol, hentriacontanol also has been found to have the ability to stimulate the plant growth. Hentriacontanol has been reported to have stimulating ability (Takita *et al.*) in the growth of Basidiomycetes. It can be used (Ullmann) in emulsions, microemulsions, cosmetic creams and lotions. It also serves as lubricant in polymer processing.

CONCLUSION

1. Study of complete chemistry of all the extracts especially, the methanol and aqueous extracts, identification of constituents is likely to provide directions for looking into alternative uses of kendu leaves.

2. The hexane extract of kendu leaf waste could be examined as a plant growth regulator/stimulator as this contains hentriacontanol, next homologue of well known triacontanol.
3. Further work is necessary to find out alternative uses of this vast renewable forest resource

ACKNOWLEDGEMENTS

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Design Considerations for Improving the Recovery of Kewda Perfume through Modified Distillation Technique

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S. Behera and B.C. Misra*

INTRODUCTION

Kewda or screwpine, botanically known as *Pandanus odoratissimus* Linn f syn. *P. fascicularis* Lam is found growing wildly in several parts of our country A densely branched shrub, rarely erect is found along the coast of India and in the Andaman Islands It is common on the sea shore forming a belt of dense, impenetrable vegetation above the high water mark This species is the most widespread and has been recorded from Mauritius Islands in the West to Polynesian Islands in the East It is highly polymorphic and has been described under several specific names. It includes numerous varieties and forms, selected in various countries for specific uses. In India the plants of this species are generally seen growing along banks of rivers, canals, fields, ponds and seashore (coast)

The trees have stem up to 6 m high supported by aerial roots, leaves glaucous green, 1-1.5 m long, caudate or acuminate, coriaceous, with spines on the margins and on the midrib; spadix of male flowers 25-50 cm long with numerous sub-sessile, cylindric spikes, 5-10 cm long, enclosed in long, white, fragrant, caudate/acuminate spathes, spadix of female flowers solitary, 5 cm in diameter, fruit—an oblong or globose syncarpium, 15-25 cm in diameter, yellow or red; drupes numerous. The male inflorescences are valued for the fragrant smell emitted by the tender, white spathes covering the flowers and for the valuable attar obtained from them

The tree begins to flower 3-4 years after planting The flowering is chiefly during the rainy season (July-Oct), although the flower collection is made in other months too The spadices take a fortnight to mature, depending upon the weather conditions. The spadices are used for extraction of Kewda absolute, Kewda attar and Kewda water A fully mature tree bears 30-40 spadices in a year Kewda attar is one of the most popular perfumes extracted and used in India since ancient times It blends well with almost all types of fancy perfumes

and used for scenting clothes, bouquets, lotions, cosmetics, tobacco and agar-batti. Kewda attar and Kewda water are used for flavouring various foods, sweets, syrups and soft drinks. They are popular in North India, especially on festive occasions. The products of Kewda distillation can be categorised under low volume, high-value products.

KEWDA TRADE IN GANJAM DISTRICT OF ORISSA

The commercial exploitation of Kewda flowers for its perfumes is centered mainly in the Ganjam District of Orissa and to a lesser extent in a few places of Tamil Nadu, Andhra Pradesh and Uttar Pradesh. Among other areas of considerable potentiality, the Balasore District of Orissa and the Midnapur District of West Bengal are the major ones. The Ganjam District of Orissa tops with a turnover of more than Rs 25 crores, from the business of extraction and supply of Kewda oil and Kewda attar to the national and international perfume markets, and accounts alone for the country's 90% and world's 50% of total production of Kewda perfumes.

It is estimated that there are about 8-10 lakhs Kewda trees wildly growing in Ganjam District spreading in an area of more than 600 hectares. Tulu, Chatrapur, Keluapalli, Panapalli, Berhampur, Meghna, Agraram, Indrakshu are the villages in the district well known for Kewda distillation and trade for the last three decades. About 200 distillation units, each having 2 to 12 batch stills, are in operation in these areas providing several thousands mandays of employment in this rural part of the country. These units are located within a distance of 20 km from the Kewda vegetation pockets. Nearly 20 million spadices are used annually for the production of Kewda oil, Kewda attar and Kewda water.

DISTILLATION PRACTICE IN GANJAM DISTRICT

Kewda distillation is carried out in the fire-heated stills using equipment of traditional type. Each batch of distillation uses about 500 flowers. The flowers are packed in a round copper vessel of about 1m diameter with about 400 litres capacity. The mouth of the vessel which is about 37.5-40 cm in diameter is covered with a tightly fitting copper cover containing a hole of about 2.5 cm diameter. The cover is sealed using moist cloth and a special quality clay, and kept tight with the help of metallic clips. Into the 2.5 cm opening, a tightly fitting bamboo vapour uptake pipe is inserted and this also is sealed with the help of cloth and special quality clay. The vapour uptake pipe known as 'Chonga' consists of two bamboos joined together at an acute angle and has a total effective length of about 2 m. The other end of the Chonga is inserted through a tightly held plug into another round bottomed copper vessel of about 20 litres capacity called 'Bhabka'. This receiver vessel is kept immersed in a tank of water for condensation and cooling. It is interesting to note that the big copper

vessel called 'Deg', the bamboo vapour uptake pipe Chonga, the receiver Bhabka and even the sealing earth is being obtained from Kanauj in Uttar Pradesh. The distillation that is conventionally practised is water distillation. To about 500 flowers, 40 litres of water is added and the distillation is started by heating from the bottom using fire-wood. It takes about 40 to 60 minutes for the material to come to boiling when the vapours pass through the bamboo tube into the receiver where they are collected over the next two hours. During this period about 3.5 to 4 litres of water and 15 to 25 ml of Kewda oil (rooh) distills over.

The heating is discontinued and the receiver is quickly replaced with another container containing about 5-6 kg of sandalwood oil. The Kewda water separated from the oil obtained in a batch on the previous day is recycled into the deg before distillation is restarted. During the next two hours of distillation, the vapours are absorbed in the sandalwood oil. At the end of this period, the receiver is removed and replaced by yet another receiver containing either paraffin oil or diethyl phthalate. The cycle of opening the deg, charging the distillate water from a previous batch, sealing the mouth and all other operations are repeated once again. During this total period of 6 hours distillation, almost all the volatile perfumery material comes out of the flowers and the residual cooked flowers and water are rejected. On cooling, the deg is ready for another operation. The quality of 'attars' obtained by absorption in sandalwood oil and in DEP (diethyl pathalate) subsequently is determined purely through oil factory sensing by experienced operators who determine the number of times the vapours are to be absorbed in the same quantity of sandalwood oil. At times, to achieve the desired quality, it is reported that up to 20-30,000 flowers are distilled.

A few attempts have been made by others in 1988-89 for survey and collection of important statistics related to the Kewda distillation technique as well as its commercial aspects. The Regional Research Laboratory, Bhubaneswar has taken up survey very recently during the peak of current rainy season and collected some information and tentative statistics which are given in Table-1. It is understood that 120 days of the rainy season alone accounts for 90% of the trade with best variety and quality of oil yield. It is further seen that most of the distilling capacity remains idle for most of the year.

DESIGN CONSIDERATIONS FOR AN EFFICIENT STEAM DISTILLATION SYSTEM

Basically, there are three types of essential oil distillation methods and they differ in the degree of content of the plant material with water/steam. In the first type called water distillation, the charge is wholly or largely immersed in boiling water (the practice followed in Kewda distillation). In the second type, the plant material is supported above boiling water by a grid and this is referred

Table-1: Average trends in Kewda distillation practice (Basis One year of standard distillation)

Season	Colour of Oil	Flower Utilisation Number	Utilisation Percentage	Oil recovery (gm/500 flowers)	Total Oil (kg)	Oil %	Flower distillation for Attar %	Water %
Summer	Light yellow	17,500	3.5	15-18	0.6	20-25	60-65	15-20
Mar-Jun	Yellow	450,000	9.0	22-25	20.7	85-90	5-10	0-5
Rainy								
July-Oct	Golden Yellow	32,500	6.5	18-20	1.20	45-50	30-35	20-25
Winter								
Nov-Feb								
Total		500,000			22.5			

to as water and steam distillation. In the third type, steam distillation, saturated steam from a separate boiler is introduced in the still. During the above operations, the oil glands of the plant material are ruptured, the oil is released, vapourised and carried with steam into the condenser. On cooling, the oil and water form two different layers and oil is separated. The first two processes have the advantage of being more easily carried out under field conditions while steam distillation, though it provides the best quality of oil, is only practised in large scale distillations.

The principle underlying the hydro/steam distillation of essential oils may be expressed as follows. The ratio between the weights of the two vapour components and therefore of the liquids in the distillate (generally) is expressed by the ratio of their partial pressures multiplied by the ratio of their molecular weights

$$\frac{W_{H_2O}}{W_{Oil}} = \frac{P_{H_2O}}{P_{Oil}} \times \frac{M_{H_2O}}{M_{Oil}}$$

where W_{H_2O} = Weight of water in the condensate
 W_{Oil} = Weight of oil in the condensate
 P_{H_2O} = Vapour pressure of water at still temperature
 P_{Oil} = Vapour pressure of oil at still temperature
 M_{H_2O} = Molecular weight of water
 M_{Oil} = Molecular weight of oil

It is pertinent to note here that Kewda oil has substantial solubility in water and the G.C. analysis shows presence of not less than 15 components (more than 0.5%) although only two components account for more than 85% of the oil. It is, therefore, obvious that the composition of oil distilling with steam at different time intervals will vary depending upon the vapour pressures of these components at the steam temperature. These factors have to be taken into consideration while designing a suitable distillation still. In addition the following engineering parameters have been considered and are described below.

Burning of Plant Material

In the type of distillation currently in practice, heating with fire-wood from bottom has to be carried out very skilfully by experienced workers. Otherwise, it is reported that at times the material affords undesirable and unexpected burnt odours to the product due to localised over-heating. Since the product is a low volume and high-value product, steam heating is considered highly desirable.

Shape and Size of the Still Container

The shape and size of the container is very much important for the following reasons:

- i) to ascertain maximum volume,
- ii) uniform steam distribution, and
- iii) to prevent undesirable refluxing, resulting in breakdown and deterioration of product.

For a maximum volume consideration, a cylindrical distillation still with a L/D (Length / Diameter) ratio of about 1.25 is suitable. The sizing of L/D ratio affects considerably the steam flow distribution. Smaller the diameter and longer the length, better is uniformity of steam distribution through the plant material. Alternatively, if the diameter is very large compared to length, steam may escape through less densely packed sections resulting in low distillation efficiency for densely packed zones. Again, when the height is large and walls not properly insulated, repeated condensation and subsequent evaporation of the essential oil takes place causing damage to the final product. A designer has to have a choice in compromising the L/D ratio between 1 and 1.5 which will keep the above consideration within reasonable limits.

Vapour Uptake Head Sealing and Condenser

The charging and removal of plant material necessitates a wide open mouth which is covered with a suitable steam uptake pipe. The mouth should be sealed tightly which may be done by gasket or water sealing, since any leakage of steam vapours will lead to the loss of essential oil. In case of water sealing, the pressure it holds within the shell is equal to the pressure of the column of water used for sealing and higher pressures are not obtainable. The build up pressure in the still is due to the pressure drop in the connecting line and condenser. Higher the pressure drop in the condenser, better will be the heat transfer coefficient and hence efficient condensation will be achieved through economically sized condensers. A still with a water sealing arrangement attains relatively a lower pressure drop at the condenser and requires a larger condenser. Gasket sealing with synthetic rubber is recommended.

The vapour uptake pipe should not narrow down suddenly to avoid throttling and consequent development of back pressure. It should taper gradually and is connected to the condenser with a pipe of adequate diameter. The condensers could be tubular or coiled. The rate of condensation depends, amongst other factors, on the area of the condensing surfaces. Tubular condensers are preferred since they provide large surface area and require much less space.

Materials of Construction

In the process plant, proper selection of material of construction is a key

factor in the plant economics. In this case of high-value Kewda products, either stainless steel or copper is recommended. However, in view of the high resale value of copper, its resistance to corrosion and higher strength and rigidity of stainless steel, a combination of copper and stainless steel is preferred.

IMPROVEMENT ASPECTS OF KEWDA DISTILLATION

The distillation for the extraction of Kewda oil is still practised in the conventional copper vessels with bamboos for carrying vapours and distillate receivers as condensers. The following points need attention for the improvement of this process

- i) The fire-wood consumption is fairly high, about 2 quintals per distillation,
- ii) the 'deg' can be replaced by a suitably designed cylindrical metallic vessel with suitable direct or indirect heating system,
- iii) the existing bamboo 'chonga' is to be replaced, and
- iv) as the receiver vessel acts also as a condenser, its efficiency is poor, particularly when the heat becomes a little more than desired.

ECONOMIC ASPECTS

Presently, Kewda absolute or Kewda oil is fetching about Rs. 2.5 lakhs per kilo gram. The Kewda attar prepared using sandalwood oil as base costs around Rs 18,000-20,000 per kg while the Kewda attar prepared using paraffin oil or diethyl phthalate fetches Rs. 5000-6000 per kg. But the cost of raw materials also has been steadily increasing. Today, a flower costs as high as Rs 7 and the costs of base oils are Rs. 7000 and Rs 200 per kg of sandalwood oil and DEP respectively.

The following paragraphs give an idea of a lucrative techno-economic feasibility of this rural industry. A standard distillation unit having 10 distillation stills, with 5 lakh flowers-annual utilisation, has been considered as the base for the feasibility estimation.

The average oil recovery in the summer, rainy and winter seasons has been taken as 17, 23 and 18 grams respectively in a batch of 500 flowers. The total oil recovery from the 5 lakh flowers works out to be 22.5 kg. It is recovered in the absolute form (Rooh), 10% in the attar form (sandalwood base) and 5% in (DEP as base). Therefore, the sale value of all these products work out to Rs 62 lakhs.

A unit of this size generates substantial man days and it is estimated that 8,000 man days are required for unit operations, related to distillation, transportation, sorting and counting flowers. This is in addition to man days required for plucking the flowers from the bushes and removal of folial matter. Total fire-wood requirement for 100 days is estimated at 200 tonnes per annum.

COST CALCULATION AND PROFITABILITY

A. Land, Building and Distillation Plant Cost

	Rs in lakhs
i) Fixed capital on land and building	2 5
ii) Equipment cost including boiler	5 0
iii) Working capital. 25% of manufacturing cost	11 0
Total fixed capital	18.5

B. Working Capital

i) Cost of flowers	35 0
ii) Cost of sandalwood oil 50 kg @ 7000/kg DEP 50 kg @ 200/kg	3 5
iii) Man power 20 man days (Rs. 60/- per day)	1 2
iv) Utilities Steam / Fuel / Water	2 0
v) Plant maintenance / Overheads	1 8
Total manufacturing cost	43 5

C. Cost of Production

Manufacturing cost	43 5
Interest on capital @ 15%	6 0
Depreciation @ 20% on plant @ 10% on building	1 0 0 25
Selling expenses/travel, etc,	1 25
Cost of production	52 0

D. Sale Proceeds

Value of Rooh 20.5 Kg @ 2.5 lakhs / kg	51.25
Attar in Sandalwood oil 50 Kg @ 18,000/ kg	9 0
Attar in DEP 30Kg @ 6000/kg	1 75
Total return	<u>62.00</u>

E. Profitability

Gross profit	10 0
Return on capital	$\frac{10 \times 100}{18.5} = 54\%$

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Production of Ethanol from Lignocellulosic Agro-Industry Residues—An Integrated Approach

M.R. Panigrahi, S. Behera, B. Mazumdar, Y.R. Rao, A.K. Sahu, J.S. Murty and H.S. Ray

INTRODUCTION

The energy crisis will become increasingly serious in the coming decades due to the rapidly decreasing reserves of conventional fuels like coal, oil, etc., in the country. As evident from Fig. 1, the major share in consumption of energy is from coal and oil sector. Fire-wood comes next which means a high rate of deforestation presently going on. If the consumption of energy continues at this rate then, by 2000 A.D., the life of coal, oil, and gas reserves would have been decreased to 150, 30, and 65 years respectively.

But, coal is less promising in view of its high ash content and cost of thermal power generation which is presently about Rs 4.0-4.5 crores rupees/MW.

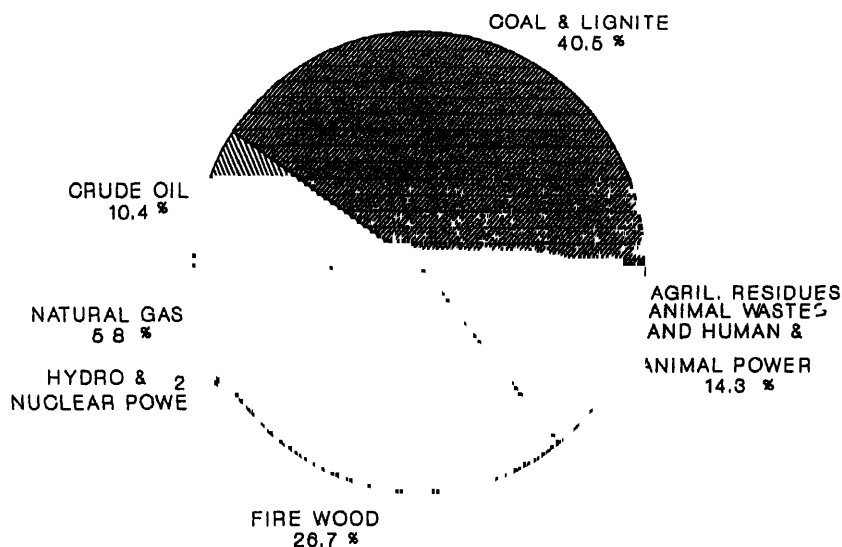


Fig. 1: Energy consumption rate in India

Therefore, attempts have to be made to derive energy from non-conventional fuels like methanol, ethanol, and bio-gas. It is interesting to note that the cost of power generation based on non-conventional fuels is of the order of 3.0-3.5 crores/MW

Gasohol programme (Gasoline + Alcohol) is successful in Brazil and to some extent in other countries like U.S. Tests have been conducted worldwide by mixing alcohol with gasoline at concentrations upto 29%, and the resulting blend can be used in gasoline engines with minor modifications. I.I.T., New Delhi has already demonstrated this in our country. Even the Minister of Petroleum & Petrochemicals has recently announced in Lok-Sabha, that upto 5% ethanol can be safely added to petrol.

Table-1 shows the requirement of motor fuel which is equivalent of 100 billion litres of alcohol. If 10% blend is used in the engine, then the alcohol requirement is 10 billion litres. Interestingly, the present production of alcohol in the country from sugarcane molasses, the only commercially important source, is about 1 billion litres only. Therefore, there is a need for alternate raw materials for production of alcohol.

Table-1: Projected Requirement of Motor Fuels in 2000 A.D.

Product	Requirement (2000 A.D.) in Million Tonnes	Alcohol Equivalent in Billion Litres
Petrol	7.00	14.00
Diesel	43.00	86.00
Total	50.00	100.00

The raw materials which are capable of yielding ethanol can be categorised into three groups: i) Sugar containing materials, such as sugarcane, sugarbeet, sweet sorghum, and molasses; ii) Starch containing materials, such as rice, barley, corn, algae, cassava, etc., and iii) Cellulosic materials, such as bagasse, wood, agricultural and forest residues, sulphite liquors, saw dust, municipal solid wastes, etc. The tropical grasses, straw, etc., are lignocellulosic in nature which contain the carbohydrate polymers. The largest fraction of the lignocellulose is crystalline cellulose which consists of long chains of glucose molecules that convert to simple fermentable sugars. The second fraction, hemicellulose, consists of polymers of the five-carbon xylose which are difficult to ferment to ethanol. The final fraction, lignin, is not a sugar molecule, but a phenolic polymer and therefore, cannot be fermented to produce ethanol.

Since the cellulosic material in the form of agricultural and forest residues are available in the rural sector, the units which make alcohol from this material would be a real boon to the rural population of the country. It should also be noted here that a number of chemicals can be manufactured starting from alcohol. These include i) Ethylene and derivatives, ii) Acetone and derivatives, and

iii) Others like Butadiene, diethyl ether, Maleic acid, Ethers, etc. Therefore, there is a scope for industrial growth in terms of alco-chemical units in the rural sector.

According to the rough estimates made by us, the annual availability of major agricultural residues in the form of rice, straw and husk, wheat straw, jowar stalk, bajra straw, ragi straw, millets straw, maize cobs and stalk, jute sticks and sugarcane bagasse is about 38MT.

About 65 million hectares of land in the country is lying either un-utilised or under-utilised for various reasons. Of this 20% utilisation for biomass cultivation would mean a possible addition of 650 MTs of lignocellulosic biomass

Table-2 gives an idea of biomass potential in the country. Through integrated approach, this 980 million tonnes of biomass can yield about 150 billion litres of alcohol which means the future fuel requirement, in part or even full can be met through the ethanol produced from lignocellulosic biomass

Table-2: Biomass Potential

A Present

I Forest Biomass @ 10T/ha, 75 Mill ha	= 750 MT
II Agricultural Biomass 60% of 386 M T	= 230 MT
	<u>980 MT</u>

B Possible Addition

Dry & Waste Lands 65 Mill ha Say 20% utilised for Biomass Cultivation yield @ 50T/ha	650 MT
--	--------

PROCESS OPTIONS FOR ETHANOL FROM BIOMASS

The four steps involved in the process for production of ethanol from lignocellulosic biomass are i) Pretreatment, ii) Hydrolysis iii) Fermentation, and iv) Recovery of ethanol. First, the feedstock is pretreated to open up the structure of cellulose and hemicellulose components and to separate sugars. Generally, alkali and steam (acid) pretreatments are practised in the industries dealing with the cellulosic biomass. In the presence of 5% alkali (NaOH), at temperature of 130-180°C, the cleavage of ether and carbon bonds readily occurs, resulting in the depolymerisation and solubilization of the lignin-polymer. The use of alkali-ethanol-water mixture is effective to partially delignify the agricultural residues (Avgerinos & Wang 1983). It has been demonstrated that partially delignified corn stover (68% removed) can be degraded at rates 4 times that of untreated material, using mixed-culture fermentation. Sulphuric acid pretreatment is done to initially convert the hemicellulose to xylose sugars (David *et al.*).

1989; Torget *et al.*, 1990). Stoichiometrically, 1 136 g of xylose is the yield from one gram of hemicellulose.

After the pretreatment, cellulose in the residue is converted to glucose by hydrolysis using either acids or enzymes. Acid hydrolysis processes are relatively well understood and can largely make use of existing chemical process equipment (Wyman 1989). Enzymatic hydrolysis process is at a much earlier state of technological maturity (Wright 1989), however, in the absence of unforeseen breakthroughs for acid-based processes, research is likely to result in enzyme-based processes that are significantly cheaper than acid-based processes. High temperature, dilute acid plug flow reactor, percolation dilute acid hydrolysis reactor, progressing batch reactor, low temperature concentrated sulphuric acid hydrolysis, liquid phase conc. hydrochloric acid and liquid phase hydrofluoric acid process are the major acid hydrolysis options. The stoichiometric yield of glucose from a gram of cellulose is 1.11 grams.

The six carbon sugars (primarily glucose sugars) are easily fermentable by the standard industrial yeasts such as *Saccharomyces cerevisiae*. But the same yeast cannot ferment the five-carbon sugars (primarily xylose). However, bacteria such as *Zymomonas mobilis* are capable of fermenting both the C₅ and C₆ sugars. The xylose and glucose sugar streams from the pretreatment and hydrolysis steps are combined and then fermented using appropriate culture. At best, 92 weight units of ethanol are produced for every 180 weight units of glucose consumed, neglecting the need for the fermenting micro-organisms for 4-10% of the sugar for growth and maintenance. Similarly, the absolute maximum yield of ethanol from xylose is 51.1%, the same as glucose fermentation. Thus, the overall absolute maximum yield of ethanol from cellulose and hemicellulose are 56.8% and 58.1% respectively.

Considerable research effort for enzymatic saccharification of cellulosic substrate has been done in India and abroad. I.I.T., New Delhi, installed a pilot plant to process 214kg/day of rice straw (5-6mm size) to obtain 40 kgs (50 litres of 93.7% concentrations) of ethanol, 25.7 kgs of lignin, 17.5 kgs of single cell protein (SCP). The process is economical if only lignin and SCP fetch good price. Otherwise cost of production is nearly Rs 35/- per litre of ethanol.

WORK DONE AT R.R.L, B.B.S.R

The Regional Research Laboratory, Bhubaneswar, based on low temperature, acid hydrolysis process, has successfully developed a process for generation of ethanol from deoiled aromatic grasses like Palmarossa, Lemon grass, Citronella, etc. The laboratory is now proposing to set up a pilot plant for (100 litres/day) ethanol based on the small scale experiments conducted on various feedstocks. Table-3 gives a list of many potential feedstocks for alcohol production. The laboratory has taken up a programme to assess the techno-economic feasibility

for production of alcohol from selected feedstocks like herbaceous crops, bagasse, bamboo dust, kewda leaves, aqua weeds, etc

Table-3: Potential Biomass Feedstocks for Alcohol Generation

(A) Residues from crops grown for purposes other than the fuel production:	
1 From Agriculture . Residues of	
(a) food crops like rice, wheat, and ragi,	
(b) cruciferous crops like mustard, radish, and rape,	
(c) tall grasses like maize, sugarcane, and jute,	
(d) aromatic crops like palamarosa, citronella, lemongrass,	
(e) root crops like potatoes, sweet potatoes, and ground nut, and	
(f) fruit crops like banana, jack fruit, etc	
2 From Industry	
Saw dust, bamboo waste, deoiled minor oil seeds, etc	
3 Natural Vegetation	
<i>Ageratum, Hyptis, Eupatorium, etc</i>	
(B) Residues from crops grown / can be grown for the fuel production	
(a) Woody or herbaceous high productivity energy crops like <i>Leucaena leucocephala</i> , <i>Eucalyptus citriodora</i> , <i>E</i> hybrid, etc ,	
(b) Trees produced by conventional forestry,	
(c) Aquatic and marine plants like water hyacinth, <i>Sargassum</i> , <i>Gracilaria</i> , etc	

INTEGRATED FLOWSHEET

An integrated flowsheet for production of ethanol from a particular lignocellulosic biomass (Palmarossa grass is presented in Fig 2) The projections of profitability are summarized in Table-4. The related data are presented in

Table-4: Projections of Profitability

	1st Year	(Rs lakhs) 2nd Year	3rd Year
Production (KL)	900	1050	1200
Raw materials & consumables	71 50	83 00	94 50
Power & Fuel	4 00	4 50	5 00
Salaries & Wages	3 00	3 25	3 50
Factory & Adm overheads	4 00	4 25	4 50
Selling Expenses	2 00	2 25	2 50
Cost of production	84 50	97 25	110 00
Sales return @ Rs 14,000/KL	126 00	147 00	168 00
Gross profit	41 50	49 75	58 00
Interest	17 90	17 50	15 20
Depreciation	24 70	19 60	15 60
Operating profit	(-) 1 10	12 65	27 20

Annexures 1 and 2. The data and assumptions for preparing these Tables and Annexures are given in Table-5

Table-5: Data and Assumptions

(i)	Installed plant capacity	5KL per day of 95% Ethyl alcohol
(ii)	No of operational days	300 in a year
(iii)	1 T of fresh grass having 55% moisture yields	150 Litres of 95% Ethyl alcohol
(iv)	Requirement of fresh grass for the plant	10,000 T per annum
(v)	Average yield of grass	40 T per hectare per annum
(vi)	Area of grass cultivation	250 hectares
(vii)	Acid requirement in the process	1.35 T per tonne dry grass
(viii)	Lime requirement	1 T per tonne of free acid present
(ix)	Cost of sulphuric acid (98%)	Rs 2800/- per tonne
(x)	Cost of lime	Rs 1200/- per tonne
(xi)	Acid recovery achievable	90%
(xii)	Cost of acid recovery	40% of the cost of acid recovered
(xiii)	Solids residue from the plant	106 Kg, with 85% lignin, per tonne of fresh grass
(xiv)	Biogas yield	22.5 m ³ per tonne of fresh grass
(xv)	The biogas is expected to generate the power to suffice at least 60% requirement of the plant	
(xvi)	The solids are burnt as fuel that is sufficient to produce energy required for the plant	

CONCLUSIONS

i) Factors like easy availability of plants and machinery, acids and other chemicals make the low-temperature acid hydrolysis process very attractive for commercial exploitation of lignocellulosic biomass, for making ethanol.

ii) Factors which are critical for success of the proposed development include a) Value-addition to xylose sugars, b) Acid recovery, c) Value-addition to lignin, d) Energy inputs, and e) Corrosion aspects.

iii) The cost of alcohol in case of non-recovery of the acids in the process works out to be about Rs 25/-per litre which still competes with the prevailing price of alcohol in the market, as a result of decontrol of molasses in the country.

iv) But, more the acid recovery, less is the price of alcohol produced. Therefore, the laboratory is presently engaged in R & D on acid recovery, an important step in the process, and

v) The laboratory at present is assessing the techno-economic feasibility of production of alcohol from various feedstocks like bamboo dust, aquaweeds, industrial cellulosic wastes, etc, which are important from the availability as well as commercial point of view

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ANNEXURE-1

Total Project Cost

(Rs. lakh)

(i)	Shed & Civil works		14.00
(ii)	Process plant & Machinery		
	Hydrolysis Tanks	2.40	
	Filters	6.00	
	Dryer	4.80	
	Impregnator	5.00	
	Fermenter	8.50	
	Centrifuges	6.00	
	Distillation column	10.80	
	Acid recovery unit	39.60	
	Others	11.60	
		94.70	
(iii)	Contingencies		27.30
(iv)	Pre-operative expenses		6.00
(v)	Working capital margin		8.00
	Total =		136.00

ANNEXURE-2**Cultivation Economics**

	Basis: 250 ha. land cultivation of Palmarosa grass	(Rs lakh)
(i)	Investment : (including infrastructures such as distillation plant, godown, irrigation facility, staff and cost of cultivation)	100.00
(ii)	Recurring Expenses .	75.00
	Land rent	5.00
	Cost of manure & fertilizers	10.00
	Intercultural operations	3 00
	Plant protection	2 00
	Irrigation	10.00
	Harvesting & transportation	5.00
	Distillation charges	20 00
	Miscellaneous expenses	5 00
	Interest	15.00
(iii)	Gross Return (oil from 10,000 T of grass with 0.35% oil content on fresh weight basis and Rs 300/- per litre of oil)	105 00
(iv)	Net Profit Gross return - Recurring Expenses	20 00
	- overheads	(5 00)
	- selling expenses	(5.00)
(v)	Return on Investment	20%

Utilisation of Gums, Starch and Tannins after Value-Addition in the Petroleum Industry

A. Sharma and R. Sharma

INTRODUCTION

MFP or NTFPs are the new developing pillars of sustainable forestry and cater to the changing needs of the people in the ever-changing environment. NTFPs are obtained from fruits, flowers, leaves, twigs, barks, roots of plants and other products from animal and mineral origin and have been usually classified under nine main categories. A number of industries are based and developed on the NTFP resources such as the Tendu leaf, Tasar silk, honey-bee, honey etc. Of the many NTFPs, gums and resins, tannins, fatty oils and starch are gaining industrial importance in the Petroleum industry.

The Petroleum industry makes use of drilling fluids. Drilling fluids are used in oil-well rotary drilling because of their primary function of removal of drilled cuttings. With the advancement of drilling-fluid technology, slowly it has been realised that there are several other functions of drilling fluids besides removal of cuttings, viz., i) cooling and lubrication of bit and drill string, ii) making an impermeable cake to consolidate its formation, iii) to control formation pressure, iv) to transmit hydraulic horse power to the bit, v) prevention of corrosion, and vi) holding drilled fluids in suspension.

The majority of drilling fluids may be classified as "water base muds". Sometimes, however, water serves as an ideal drilling fluid where trouble-free low-pressure formation zone exists.

PROPERTIES OF DRILLING FLUIDS

During any drilling operation, it is vitally important to control the physical properties of the 'mud', as it is frequently called. The properties have to be controlled at values such that the drilling mud may give an optimum performance. The most important properties for control are the 'viscosity' and the gel strength of the mud. Another property that needs to be controlled is water/fluid loss or filtration. In order to prevent formation fluids from entering the bore hole, the hydrostatic pressure of the mud column must be greater than the pressure of the fluids in 'pores of the formation'. Consequently, mud tends to invade the permeable formations. The loss of fluid (usually water and soluble

chemicals) from mud into the formation occurs only when the permeability is such that it will allow the passage of fluids between the pore openings. The mud solids are filtered out on the walls of the hole forming a cake of relatively low permeability through which only filtrate can pass. Muds must be treated to keep cake permeability as low as possible in order to maintain a stable borehole and to minimize filtrate invasion. This will prevent any damage to potentially productive zones

As mentioned earlier, some NTFPs such as gums, resins, oils and their chemically modified forms are in wide use for controlling both rheology and fluid-loss properties of drilling fluids. These NTFPs and their modified products act as viscosifiers, flocculants, dispersants and filtration control agents. Besides this the modified natural oils are even used for 'bit and drill' string lubricity

Some of the *water-soluble* NTFP polymers used in drilling fluids include the '*natural polymers*' derived from various plant species.

(A) **Natural polymers** (Carbohydrate polymers or polysaccharides) are macro molecules all of which contain hydrophilic groups. Chemical modification of natural polymers involve either an improvement in its structure or incorporation of one or more of the structural features such as branching, ionising groups, bonding and non-uniformity in the repeating structures. Some examples of natural polymers derived from various NTFP species may be briefly enumerated as follows :-

(a) **Starch** from *tapioca* or *Manihot esculenta* Crantz, is the most commonly utilised natural polymer. It was introduced as a 'fluid loss' reducing agent in the late 1930s. Starch as utilised in drilling fluids is unsubstituted, non-ionic, has a linear backbone and is soluble in a high concentration of salt. Starch is peptised or pregelatinised to improve its solubility or dispersion in aqueous system. Other common sources of starch utilised in drilling are corn (*Zea mays* Linn.) and potato (*Solanum tuberosum* Linn.) Apart from being a fluid loss control agent, it also promotes shale inhibition.

(b) **Guar gum** from *Cyamopsis tetragonoloba* Taub., is a naturally produced non-ionic polysaccharide (MW about 220,000). It is a branched polymer, made up of mannose and galactose. The polysaccharide is able to hydrate in different type of mixing waters and is highly compatible with monovalent metallic chlorides, the salt tolerance being affected by salt concentration and pH. It is used as a viscosifier and fluid loss reducer in drilling fluids.

(c) **Locust Bean Gum** from *Ceratonia siliqua* Linn., a natural polymer is used in drilling fluids to suspend weighing materials and also as a fluid loss control agent. Structurally, it is similar to guar gum except that the mannose to galactose ratio is 4 in contrast to that of in guar gum which is 2.

(d) **Xanthum gum** is a biopolymer, produced by the action of a micro-organism, '*Xanthomonas compestis*' on carbohydrates. It has an extremely complicated structure (MW= 2 million) and is used as a viscosifier and

suspending agent. Recently, a purified liquid version of Xanthum gum was introduced by Pfizer for application in enhanced oil recovery.

Apart from natural polymers, there are some 'modified polymers' which are nothing but the derivatives of natural polymers.

(B) Modified polymers : The most commonly used modified polymers are carboxy methyl cellulose (CMC), hydroxy ethyl cellulose (HEC), Carboxy methyl hydroxy ethyl cellulose (CMHEC) and hydroxy propyl guar gum (HPG). The modified natural polymers are used as viscosifiers and fluid loss control agents in drilling fluids

The modified polymeric versions are usually synthesized by the treatment of cellulose with caustic soda and then further reaction of the soda-cellulose with different agents for imparting different properties such as water solubility, etc

Other natural polymeric NTFPs that are in use in the Petroleum industry are 'Tannins' and 'Lignins'

(C) Tannins are obtained from the plants of '*Acacia* species'. The most commonly used tannin for 'mud control' is Cutch obtained from *Acacia catechu* Willd., and tannins from *Quebrachia colorado*. It is an acidic material and is to be used with caustic soda to maintain the optimum pH of the mud in the drilling technology. The tannins may also be used as 'dispersants' or 'thinners'.

(D) Lignins are a major component of wood binding together, the bundles of cellulose fibres. Lignins may be chemically treated to form ligno-sulphonic acids. Lignins and/or ligno-sulphonic acids may be used as dispersants and fluid loss control agents

(E) Fatty acids and oils . Some plants products such as fatty acids and oils obtained from different plants are also used in drilling fluids in *natural* and *modified* forms as '*extreme pressure lubricants*' for drilling 'bit and strings'. The most widely used oil is 'Castor oil', obtained from the plant – *Ricinus communis* Linn. The modified castor oil, after its sulphonation, may be used both as lubricant and/or as a detergent (surface active agent)

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Section 11

NFTP-ORIENTED SUSTAINABLE FOREST MANAGEMENT FOR ECOSYSTEM CONSERVATION AND BIODIVERSITY MAINTENANCE

Conservation Needs of Important MFP (Minor Forest Products) of Nepal

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INTRODUCTION

Himalayan vegetation, due to its altitudinal variations and diverse physiographic condition, has sheltered a great variety of plants there by giving rise to a high degree of biodiversity in its flora. Nepal, being situated in the central part of the main Himalayan range, is under the influence of both eastern and western Himalayan elements. It has an altitudinal range of 56 m at the plains of Terai to 8848 m, the top of Mt Everest (the highest peak of the world), forming distinct bioclimatic zones from tropical to alpine constituting more than 35 different forest types (Stainton, 1972). This environment has been favourable for the growth of diverse plant species and hundreds of them have great medicinal and economic value.

Being highly mountainous and agricultural country, a big mass of population, especially the rural one, is traditionally dependent upon forest resources for their daily requirements and to a large extent their socio-economic life is also deeply influenced by these abundantly available resources. Besides their local utilization, the different forest products, through their export, play a significant role in the national economy. The forest products also serve as raw materials for different types of industries. The products produced by the pulp and paper industry, match factory, flooring industry, etc., situated in different parts of the country, fulfil the national needs to a great extent. Other important products include fibres, essential oils, dyes, tannins, gums, resins, etc. The leaves of some plants are also used for thatching of roof, making umbrellas, and wrapping bidis, etc. But most of the common and frequent use comes from medicinal plants, especially of wild origin, for curing various diseases from ancient times.

In recent decades, due to over exploitation of the forests, timber has become a scarce material and will remain so in the foreseeable future. Therefore, presently, the attention has been turned to other forest products with high economic returns. These forest products, especially medicinal herbs, growing on the mountain sides, are being harvested from the wild and are being regularly supplied to the plains and are traded outside.

Due to ever growing demand for various forest products, a strong need has

been felt for the constant supply of these products to the local consumers, in addition to household consumption and specially to Ayurvedic industries - traditionally run and new emerging ones, and also to meet the demands from outside. As the revenue earned by these items is pretty big, it has become highly essential to assess the present status (quantitative and qualitative) in the national context. According to the publications of Department of Medicinal Plants (DMP 1976, 1984) there are about 571 plant species, with acclaimed medicinal properties, found in Nepal. Some 120 species, either exotic or indigenous have been naturalized or cultivated for long (Malla and Shakya, 1985).

At the national level, it was not a matter of a great concern, until these plants of commercial value appeared as scarce commodities. No special attention has been paid for the proper management of these growing in the wild. Department of Plant Resources is mostly active in the research of the different disciplines of Botany and development of natural products. Some of the herbal farms owned by the Department of Plant Resources have been now handed over to HMG company, the Herbs Production & Processing Co., Ltd., previously engaged in the cultivation of mostly exotic medicinal plants, situated at mid-hills and tropical belts of the country. To integrate these studies with the forest conservatory programmes, policies and action plans were formulated with the inception of Forestry Master Plan in Nepal (adopted HMG in 1989).

Studies have been carried out by the present authors on resource information of MFP in Nepal, confining to one specific area of FRIS that commands a high local and national economic interest in forestry sector of Nepal. The inventory methodology designed for making the quantitative assessment of MFP has been described elsewhere under the project of Forestry Sector Institutional Strengthening Programme, Component No. 2, FINNIDA (Malla *et al.*, 1993b and 1994).

In continuation to this, field trials are underway in order to design a methodology for the quantitative assessment of MFP (Malla *et al.*, 1993b, 1994). However, to arrive at a general conclusion to find a common and practicable methodology for ascertaining the availability of MFP in the wild, is yet remote. Difficulties also lie in the MFP plant species which grow in dissimilar habitats with different types of distribution pattern. Moreover, rugged and undulated mountain topography have their own role on display.

In this paper an attempt has been to deal with ten valuable medicinal herbs growing in Nepal and their conservation needs in the present context. These plants have been selected on the basis of their wide range of distribution, high commercial demand, yielding significant revenue to the national exchequer and of recognised social popularity. Most of them grow in the fragile mountain ecosystem, destruction of their habitat is taking place at a faster rate due to various human activities.

SOME IMPORTANT MFP OF NEPAL

Here, general features of 10 important MFP found in Nepal are described along with their properties, (Anonymous, 1976; Hara *et al.*, 1979, 1982; Polunin & Stainton, 1984) in addition to the authors' own observations and experiences

***Asparagus racemosus*:** This is a tall, perennial herb, often much branched and climbing with straight or curved spines on the stem. It is distributed from 600 to 2100 m altitude confined to the tropical and sub-tropical sal forests. It is gregariously found on N/E and S/W facing slope with little moisture on the ground. The tubers are often taken as tonic. A mixture of honey and fresh root juice is highly effective in dyspepsia. The rootstock is also largely used in the preparation of medicated oils, prescribed for nervous and rheumatic complaints.

***Bergenia ciliata*:** This is a perennial herb. It is distributed from 900-1700 m altitude. Usually it is found in specialised localities with abundance and prefers rocky habitat with steep slopes. The rootstock is very stout and is said to be used in fever, diarrhoea and cough and is believed to flush out kidney stones.

***Cinnamomum tamala*:** This is a moderate sized evergreen tree. It is distributed from 450-2000 m altitude. It grows as component species of the forest. The leaves and bark are used as spices. The thin dark brown bark is aromatic and is often used as a substitute for cinnamon. Medicinally, the leaves are carminative and are used in colic and diarrhoea.

***Nardostachys grandiflora*:** This is an erect, perennial herb growing at high altitude (3250-5000 m). The whole plant has a very distinctive and lingering smell. It is the 'Spikenard' of the ancients and is a favourite perfume. The root is an excellent substitute for valerian and is used in many medicinal treatments while the oil obtained from the root is used in many medical preparations and is well known as a hair tonic. The rhizome is considered as a tonic, stimulant, antispasmodic, stomachic and laxative. An infusion of the rhizome is reported to be useful in epilepsy, hysteria, palpitation of the heart and chorea.

***Picrorhiza scrophulariiflora*:** This is a perennial herb growing at high altitude (3500-4800 m) but its distribution is restricted to certain habitats. The stem is generally creeping. The rootstock is stout and is considered to be a valuable bitter tonic almost as efficacious as gentian. It is antiperiodic, stomachic, laxative - in small dose, cathartic - in large dose. It is reported to have beneficial effects in dropsy. It is also used for curing fever and used as febrifuge. Alcoholic extracts are found active against certain kinds of bacteria. In traditional medicine, it is given to cure Hepatitis.

Rheum australe: This is a stout and tall herb growing up to 3 m or so. Its altitudinal range starts from 3200 m and usually goes up to 4200 m. It is almost confined to dry, rocky and sunny slopes of the mountain. The petiole and rhizome are used for medicinal purpose as well as for dyeing material. Powdered roots are used for cleansing teeth and also sprinkled over ulcers for quick healing. Leafstalks are eaten either raw or boiled with salt and pepper. Leaves and flowers are also edible.

Rubia manjith: This is a prickly creeper or climber with perennial rootstock. It is distributed from 1200 to 2100 m altitude. The plant (mainly rootstock) is used for dyeing coarse cotton fabrics, woolen blankets and carpets. The roots are also credited with tonic, astringent, antidyenteric, antiseptic properties. They are used in rheumatism and form an ingredient of several Ayurvedic preparations. Roots are said to be active against certain types of bacteria.

Swertia chirayita: It is an erect, annual herb growing on the marginal forest land and open fields. It is usually found from 1500-2500 m altitude. It is much prized as a tonic which is bitter without aroma or astringency. It is used in fever, anaemia, bronchial asthma, liver disorder. It is also credited with laxative, stomachic, antihelminthic and antidiarrheal properties. It is also used in liquor industry as a bitter ingredient. Due to its popularity and broad international market, local farmers in the eastern part of Nepal have begun to cultivate it in their farmlands by collecting its seeds and seedlings from the forest areas.

Valeriana jatamansi: This is a perennial, slightly hairy, tufted herb specially confined to marginal lands and in the vicinity of the forest. It is distributed from 1500 to 3300 m altitude. Dried rhizomes are used in perfumes, as incense and in hair preparations. It is prescribed for nervous unrest and emotional disorders. In mountain sides of Nepal the powdered rhizome is used for rheumatism and gout. The extract showed antibiotic activity against certain kinds of bacteria. The oil is used as adjunct of certain flavours for tobacco, honey, and beers. In medical preparations, it is used as tonic and stimulant.

Zanthoxylum armatum: It is an armed, scandent small sized tree, mostly found in and around the fields and also in the river valleys. It is distributed between the altitude of 1100 - 2500 m. The fruits are to the size of a black pepper and are used as spices or chewed as digestive. It has carminative, stomachic and antihelminthic property. The fruits are employed as an aromatic tonic in fever and dyspepsia. Oil is antiseptic and is used in soap making and dental preparations.

HARVEST FROM NATURE, COLLECTION PERMIT AND OUTSIDE TRADE OF MFP OF NEPAL

Annually, hundred of tonnes of MFP are harvested from nature and traded outside. A small part of them is locally consumed. It is often claimed that the quantity of MFP collected from the wild is far more bigger than the permitted one. These MFP items, demanded from outside, are finally collected by the dealers who are already well-informed about the market situation and have gathered long experience from generations. They have wide connections with the primary collectors of the remote areas who harvest them and bring down to the local market in the plains of Terai. The existing rule exempts seeking permission from District Forest Office (DFO) for the harvest of MFP in the mountains and high mountainous areas, but it is a must in the low lying areas in Terai and small hills. However, in actual practice, the local collectors or dealers take collection permit from the DFO only after harvesting them from their respective localities when they are to be transported from one district to another or during their transaction. Tables-1 and -2 adopted from the study of Malla *et al* (1993 a) give a comparison of the items licensed by the DFOs and the quantity collected by the dealers to dispatch outside from different parts of the country. The data from the D F Offices include the records of 58 districts (out of total 75 districts of Nepal). The rest 17 districts have either very small collection or they have been included in the previous data as there is no strict rule that the license should be issued from the district of plant origin. The data presented here are

Table-1: Collection permits issued by 58 District Forest Offices for collection of MFP (total quantities) in the fiscal years 1989/90-1991/92 and 3-6 months of 1992/93 (Approximate of 33 years)

S No	MFP item	Weight (tonnes)	Approximate average of one year	Number of supply-ing districts
1	<i>Asparagus racemosus</i>	391	118	22
2	<i>Bergenia ciliata</i>	82	24	13
3	<i>Cinnamomum tamala</i>			
	(a) Bark	631	191	29
	(b) Leaf	224	67	15
4	<i>Nardostachys grandiflora</i>	220	66	15
5	<i>Picrorhiza scrophulariiflora</i>	89	27	22
6	<i>Rheum australe</i>	119	36	19
7	<i>Rubia manjith</i>	84	25	20
8	<i>Sweritia chirayita</i>	307	93	27
9	<i>Valeriana jatamansi</i>	11	3	8
10	<i>Zanthoxylum armatum</i>	1	0.3	2

only available for the fiscal years 1989/90-1991/92 and 3-6 months of 1992/93 issued from D F, Offices, whereas the data collected from the dealers are based on the survey made by a team (including present authors) during winter of 1992 at different trade centers and exit points of the country

Table-2: Volume of MFP items collected at different trade centre (as reported by dealers)

S No	MFP item	A	B	C	D
1	<i>Asparagus racemosus</i>	8	12	23	129 60
2	<i>Bergenia ciliata</i>	3	4	12	361 00
3	<i>Cinnamomum tamala</i>				
	(a) Bark	8	12	8	230 00
	(b) Leaf	7	7	8	67 00
4	<i>Nardostachys grandiflora</i>	4	5	12	200 00
5	<i>Picrorhiza scrophulariflora</i>	6	9	15	97 50
6	<i>Rheum australe</i>				
	(a) Rhizome	3	4	12	50 00
	(b) Petiole	3	3	12	17 15
7	<i>Rubia manjuth</i>	3	4	11	38 30
8	<i>Swertia chirayita</i>	7	17	17	267 60
9	<i>Valeriana jatamansi</i>	4	4	15	55 70
10	<i>Zanthoxylum armatum</i>	8	15	14	1255 70

A - No of collection centres gathering the item

B - No of dealers interviewed

C - Districts or regions of original collection

D - Quantity/annum (tonnes)

In order to develop a methodology for the quantitative estimation of medicinal plants available in the wild, field trials were made for *Rheum australe* and *Asparagus racemosus* in the high mountains and foothills of Siwalik/Terai areas of Nepal respectively (Malla *et al.*, 1993 b). In case of *R. australe*, belt transect method (10 m wide and 300-500 m long) at an interval of 100 m was applied to test its applicability where 45, 60, 66 and 74 plants were found per hectare at four different sites respectively. In case of *A. racemosus*, circular plots ($r = 12.7$ m) were made and were sampled at fixed intervals of 100 m distances at 4 directions of the compass. In this way 125, 20 and 48 plants were found at three different sites respectively on per ha basis. An inventory programme in association with the forest inventory plots is also being tested as an alternate. But these studies are presently in the process of testing phases.

DISCUSSION

A review of the present state of depletion of the resources obviously shows that with the increase of population and lack of employment opportunities, people, in search of food and shelter, have encroached the forest areas, aiding to further degradation of the natural environment and destruction of the natural habitat.

that has provided shelter to many plants of medicinal value. According to Ayurvedic physicians, there is a very likely possibility of losing the effectiveness and quality of Ayurvedic medicines for want of availability of the genuine components, plant/plant parts used in the preparation of the medicine.

Tables-1 and -2 provides a general picture of the harvested quantities of the important MFP every year in the country. The comparison of the amounts between the licensed by D.F. Offices (total of 33 years and approximate average of one year) and the data obtained from the local dealers per year shows more or less similar quantities in case of *Asparagus*, *Cinnamomum*, *Rheum* and *Rubia*. But there is a big difference in the case of *Bergenia*, *Nardostachys*, *Picrorhiza*, *Swertia* and *Valeriana*. In case of *Zanthoxylum*, the figure is very much contrasting and it seems that the actual records are missing somewhere. It is quite probable that this item might have been traded as a spice like ginger, turmeric, etc. It is almost clear that the plant materials are over-harvested from nature than the permitted volume. So, it is very essential to have a real picture of the quantity available in nature to make a sustainable harvest for ensuring perennial supply of these items.

The existing rules and regulations for the collection and export of the MFP are not conducive for the healthy functioning between the dealers and the Government personnel. Often there are conflicts between the collectors/dealers and the custom officers, policemen, etc.

There seems to be a lack of research data regarding the plant populations in the wild and their availability towards fulfilling the ever increasing demand of the materials on a sustainable basis. A good management system cannot be developed without supportive activities of research. It is also equally important to assess the overexploited and under exploited area/parts of the country.

These items were regarded as minor forest products in the recent past and hence no proper attention was paid regarding their management. So far they have been grossly neglected. As timber trade has drastically declined and is almost negligible now, people in different quarters have started realizing the importance of MFP. The revenue and hence the foreign currency earned through them, either from raw export or as value-added items, is getting pretty big. Now, these items are being popularly called NTFPs (Non-timber Forest Products) as they are far from minor in importance. The strong need for conservation and regular supply to the industries of these items and also for local use has been almost established. To check the over exploitation and to keep it within regenerative capacity in nature, the Government, as a primary step, has banned the export of *Nardostachys grandiflora* and *Valeriana jatamansi*, with some other items in crude forms, but their trade within the country is, however, allowed. It is hoped that the effort will further strengthen and find a right direction towards the conservation of all MFP, whether big or small in importance, in the broader perspective of Forestry development.

SUGGESTIONS

Here, some of the suggestions are given for the conservation purpose and overall promotion of the MFP items growing in the mountain environment of Nepal

- i) Effective programmes to promote awareness and the impact on environmental degradation and depletion of plant resources among the villagers and dealers involved in MFP affairs should be regularly conducted. The existing rules and regulations of forests and collection of MFP should be revised and updated and made simple and practicable for smooth working between collectors/dealers and Government personnel.
- ii) To know the real status and consequently for the quantitative assessment of MFP in nature, appropriate methodology should be developed leading to nationwide inventory works. The resource should be utilized within its production limits. For longer strategy, the plants in high demand should be brought under cultivation and their propagation techniques should be developed as early as possible to disseminate among the farmers.
- iii) The banning of foreign trade of threatened MFP items including *Nardostachys grandiflora* and *Valeriana jatamansi*, is not only sufficient, but also geographical regions in which they occur should be given priority for conservation and better management.
- iv) Difficult topography, identification of natural habitat, wide range distribution of the plants, etc., pose a difficult problem for the proper quantification study of these plants. Therefore, small areas, with high or low concentration of the plants, should be taken into account at first and tried to grasp the characteristics of the plants in question. This experience should be expanded in other regions rather than taking big areas and getting nowhere, as has happened to many of the projects of this nature in the past.
- v) While working with some plants like *Rheum*, *Asparagus*, etc., in the mountains and also in relation to forest types, a positive correlation has been found between the habitat, associated plants constituting the community and major forest types. These vegetational or ecological indicators may be helpful for delineating the areas of their growth for the development of conservation strategy.
- vi) Site preference in relation to soil type, ground condition, aspect, slope, etc., has also been observed in some cases which may be incorporated for studying the range of distribution of the plant for further development of the inventory system of important MFPs in nature.
- vii) According to Rio Declaration (UNCED, 1992), the first beneficiaries of the conservation and sustainable use of wild plant and animal species should be the rural communities and indigenous people whose traditional

knowledge and respect for these resources has preserved them for centuries. Most of the persons involved in MFP (i.e., primary collectors, sellers, users, informants, etc.) are local people. They wholly or partly depend upon it for their livelihood. They should be made the target group primarily to elicit awareness for conservation and management of these MFP.

- viii) As foresters, rangers, policemen, custom personnel are involved at different stages of management and control of MFP, proper understanding regarding the utility value and correct identification of the plant or the plant part in use is highly essential for them. Training to impart this knowledge to them should be organised as a part of official function at national and regional levels, etc., at regular intervals.
- ix) As the Himalayan mountains are young and fragile, the forest and MFP management should go together and should be studied in ecosystem approach. At high altitude, these plants should only be exploited at an appropriate stage of maturity leaving the germplasm at the site to facilitate them to reproduce and multiply by themselves. These need less effort but very vital part of the management aspect, which may be quite beneficial to other mountainous countries having similar types of problems. Occasionally monitoring of the areas should be given due attention, and
- x) For conservation, management and cultivation, rural people should be involved and supported either through CFDP (Community Forestry Development Programme) or on a separate scheme. As there is fluctuation of demand in the local and international market, a Committee should be entrusted for regular assessment of supply and demand position, and ensure that these items produced through such community should be purchased by the authorised agencies in the private and also by the Government sectors for their proper trades and utilities.

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Developing Sustainable Forestry through Revival of NTFPs in Aravallie Eco-system

S.K. Verma

INTRODUCTION

The rapid increase in human and cattle population along with pressures of development like extension of agriculture, urbanisation, industrialisation, communication network, irrigation and hydro-electric projects, mining, etc , have caused rapid rate of deforestation due to removal of 130 million m³ of fuel-wood against annual increment of only 40 million m³ and the industrial wood consumption is 28 million m³ per annum while the annual growth of timber in forests is just 12 million m³. Similarly, the livestock require 980 million tonnes of green and 780 million tonnes of dry fodder annually but only 250 and 414 million tonnes respectively are provided. The rest comes from indiscriminate grazing in the forest.

The focal point, which has emerged strongly these days is the people and their participation. This has to be reviewed in the background of rural people, living in 0.6 million villages in the country, of which 0.1 million villages are located in and around the forests. The day to day requirements of various forest produce of nearly 80 million people and 50 million cattle are met by these forests.

The forest dwellers depend on forests for food, fuel, fibre, fodder, timber for their agricultural implements and housing whereas people on the forest periphery depend on the forests for their needs of fuel-wood, grazing, employment, etc.

NON-TIMBER FOREST PRODUCTS

Various types of Minor Forest Products, now renamed as Non-timber Forest Products (NTFPs), are very important. The diversity of these products is so large and their utility in day to day life-style of forest dwellers is so great that it becomes essential to incorporate these NTFP yielding plants in future programmes of forestry development.

Various types of Minor Forest Products or Non-timber Forest Products (NTFPs) are as follows

- i) Medicinal plants,

- ii) Edible wild plants,
- iii) Gums, oleo-resin and resins,
- iv) Vegetable tannins,
- v) Organic colouring dyes,
- vi) Saturated fatty oils - seeds,
- vii) Plants yielding essential oils,
- viii) Katha and Cutch,
- ix) Sources of Oxalic-acid,
- x) Fibres and Flosses,
- xi) Beverages (Non-alcoholic and alcoholic) and Narcotics plants,
- xii) Fodder and Forage plants,
- xiii) Bamboos and Canes,
- xiv) Plants useful as Bio-pesticides, Bio-fertilizers, Green manure,
- xv) Ornamental and Paper and Pulp purposes, and
- xvi) Animal Products, e g., Honey, Wax, Lac, Silk Tusser, etc.

The contribution of NTFPs in forest revenue and export income is estimated to be 50 and 70 per cent respectively. Thus, these are important for any Afforestation and Tree Planting Programmes, and need effective participation of forest-dwellers under JFM and can provide direct benefits to the local economy by involving low income groups, landless people, marginal farmers and tribals. These products provide supplementary incomes by using simple technologies and are often household based.

Collection Method and Marketing

Most of the NTFPs occur in widely scattered areas making their economic exploitation difficult. Different methods are prevalent for selling the right of collection of NTFPs, either by auction or lease. There are Forest Development Corporations, LAMP Co-operative Societies of Tribal, Co-operative Federations purchasing the monopoly of collection of NTFPs. The products are then sold to the whole-sale dealers and NTFPs pass through several hands from the primary collection stage to the consumer. Quality is not maintained as some of these products are perishable and season-oriented and also due to usage of unscientific methods of collection and storage. Normally, NTFPs are collected haphazardly and sold locally. The NTFP passes from the collector, mainly tribals to LAMP Co-operative Societies purchasing centres but mostly this does not happen due to the bureaucratic approach of the Officials of LAMPs and instead NTFP goes to the local shop-keeper or money lender of the village at throw-away price or whatever price is offered or even to clear the pending loans and interest. Normally 2 to 3 persons from each household are engaged in NTFP collection. During summers, entire women folk and children are engaged in Tendu-leaf collection work. Similarly, non-edible oil seeds and flowers, fruit and seeds of Mahua, Khajur, vegetable tannins, gums, and oleo-resins, essential

oils are collected. Occasionally the end-products are adulterated for larger gains. NTFPs individually may not be of high value but collectively these are of immense value not only for the collector (Tribal) but also, to the society as a whole.

NTFPs OF ARAVALLIE ECO-SYSTEM

The Aravallie eco-system comprises mainly of Aravallie hills, one of the oldest mountains in the world. The Aravallie hill ranges extend over a length of 692 km from the south Palampur in Gujarat, to Rajasthan, Haryana and Delhi in the north-east. The eco-system possesses vast variety of natural resources, such as vegetation and medicinal plants, wild-life, livestock, different life-style of people and cultural heritage. The Aravallie eco-system is the life-support system which determines the quality of life and prosperity of the people of the present and future generations in northern India, i.e., the states of Gujarat, Rajasthan, Haryana and Delhi. Desertification and excessive exploitation of natural resources like water, minerals, forests due to rise in population and development pressures have disturbed the ecological and environmental equilibrium

In spite of degradation of forest resources and depletion in the biodiversity of Aravallie Eco-System, there are still many useful plant species in arid tracts of Northern Aravallies and semi-arid areas of Central and Southern Aravallies. An attempt has been made to document the various plant species of the Aravallie eco-system

The 85 plant species yielding NTFPs have been grouped into a) trees -(47), b) shrubs -(26), and herbs and grasses -(12) The details are available in Annexure-I The commonly used NTFP species for various purposes are given below in tabular form

Sl No	Species used for	Trees	Shrubs	Grasses/Herbs	Total
1	Medicinal	20	13	3	36
2	Edible wild plants	21	10	3	34
3	Gums, Oleo-resin	18	-	-	18
4	Vegetable tannins	11	2	-	13
5	Organic colour dye	11	2	-	13
6	Fodder and forage	13	-	5	18
7	Fibres	6	3	2	11
8	Flosses	3	-	-	3
9	Ornamental values	10	1	-	11
10	Oils-saturated fatty oil	12	-	-	12
11	Beverages and Alcohol	2	-	-	2
12	Others	11	-	-	11

Forests provide not only fuel, fodder, fibre, but also food security to rural masses, especially tribals. These tribals meet 20-25% of their annual food

requirements from the natural forests. The forest trees and shrubs substantially contribute towards edible fruits and oils whereas the tubers, rhizomes and corms are rich in carbohydrates and minerals. The collection of edible forest produce in Rajasthan and Gujarat during 1986, is given below in tabular form

Sl No	Name of NTFPs	Collection in metric tonnes	
		Rajasthan	Gujarat
1	Mahua flowers	370 70	6010 00
2	Mahua seed	-	668 00
3	Bahera	97 37	215 00
4	Aonla	16 90	1 36
5	Chironji	4 31	-
6	Gum	289 25	-
7	Honey & Wax	16 80	6 45

USEFUL PACKAGES FOR NTFPs

In hilly regions of Aravallies some packages have been evolved which are very useful to the local people. These packages could either be practiced at the i) individual and/or ii) community levels through Tree Growers, Co-operatives, Village Forest and Development Committees or User's Committees. These packages can be integrated with Agriculture, Horticulture, Forestry, Watershed Development works. They can be implemented in the following options:

- i) **Farm Forestry:** by integrating multipurpose trees/shrubs and other plants species yielding NTFPs with agriculture in the form of fences, bund forestry, wind breaks or as a separate component on vacant 'Khatedari' land holding
- ii) **Agro-forestry:** by cultivating trees along with annual crops as Agri-silviculture, silvi-pastoral and agro-silvipastoral
- iii) **Home gardens:** by cultivating herbaceous crops, trees, vegetables and livestock within the compounds of the local people

Some of the examples of such packages are given below:

1) *Jatropha curcas* (Ratanjot) Plantation

This is a multipurpose species for degraded sites on gravelly and sandy-loam soils and can withstand temperature variations and light frost and drought as the water requirement is low. It is an ideal choice for eco-development of wastelands of Aravallies as well as for substantial economic support to individuals and communities. This plant is a large shrub, 1-2 m in height. It forms effective

live-hedge around cultivated fields in Southern Aravallies. The seeds of *Jatropha* contains oil with 21% saturated fatty acids and 79% unsaturated fatty acids. The oil has a high saponification value and is being widely used for soap manufacture. The latex of *Jatropha* contains 'Jatrophine' which is believed to have anti-cancerous properties. The oil cake is also rich in nitrogen, phosphorous and potassium and can be used as an organic manure.

This can be grown by direct sowings as well as by branch cuttings. For Block Plantations under rainfed conditions, 2500 plants/ha. can be grown at 2x2 m spacing. Under partially-irrigated conditions, 5000 or 4444 plants/ha. can be grown at 2x1 m or 1.5 x 1.5 m spacing. For linear planting along the farm boundaries, this can be grown at spacing of 1.5 m. From 2nd year onwards, the yield of oil-bearing seed is 1 kg and 3 kg per plant under rainfed and irrigated conditions respectively. At the current market price of Rs. 3.50 per kg of seed, the estimated net return from 1000 plants would be Rs. 3500 per annum. The cash flow chart for raising 1000 plants is given below in tabular form.

Year of Plantation	Expenditure (Rs.)	Income (Rs.)	Net (Rs.)	Cash flow
1st	5000	-	(-) 5000	- 5000
2nd	1500	3500	(+) 2000	- 3000
3rd	500	3500	(+) 3000	-
4th	300	3500	(+) 3200	+ 3200
5th	300	3500	+ 3200	+ 6400
6th	300	3500	+ 3200	+ 9600
7th	300	3500	+ 3200	+12800
8th	300	3500	+ 3200	+16000
9th	300	3500	+ 3200	+19200
10th	300	3500	+ 3200	+22400
11th	300	3500	+ 3200	+25600
12th	300	3500	+ 3200	+28800
13th	300	3500	+ 3200	+32000
14th	300	3500	+ 3200	+35200
15th	300	3500	+ 3200	+38400
	10600	49000		

Due to its economic feasibility, the financial support is readily available from the financial institutions.

ii) *Ailanthus excelsa* Plantations

Due to scarcity of fodder in Northern Aravallies, the leaf fodder of *Ailanthus excelsa* locally known as 'Ardu' is very popular due to its economic viability under Farm Forestry Programme in areas with a minimum rainfall of 600 mm. *Ailanthus* plantations can be raised as a Block Plantations or in linear strips.

along the farm boundaries. The spacing adopted is 4 x 6 m. In linear strips the spacing between two plants is 6 m. As *Ailanthus excelsa* is prone to frost damage, antifrost measures like additional irrigation during winters and protection of young plants with brushwood cover during frost period is advisable. During dry period the plants are irrigated twice.

The yield of leaf fodder per tree from loppings from 5th year onwards is 40 kg upto 7th year, 60 kg up to 10th year, 100 kg up to 15th year and 150 kg-16th year and onwards. As a minimum rate of Rs. 0.25 per kg each tree is expected to yield financial returns of Rs. 10 up to 7th year, Rs. 15 up to 10th year, Rs. 25 up to 15th year, and Rs. 37.50 from 16th year and onwards.

The expected cash flow from *Ailanthus* plantation (Unit 400 plants) is given below in tabular form.

Year	Expenditure (Rs)	Returns (Rs)	Net (Rs)	Cash flow
1st	5300	—	— 5300	—
2nd	1750	—	— 1750	— 7050
3rd	750	—	— 750	— 7800
4th	750	—	— 750	— 8550
5th	150	3200	+ 3050	— 5500
6th	150	3200	+ 3050	— 2450
7th	150	3200	+ 3050	+ 600
8th	150	4800	+ 4650	+ 5250
9th	150	4800	+ 4650	+ 9900
10th	150	4800	+ 4650	+14550
11th	—	8000	+ 8000	+22550
12th	—	8000	+ 8000	+30550
13th	—	8000	+ 8000	+38550
14th	—	8000	+ 8000	+46550
15th	—	8000	+ 8000	+54550
	9450	64000	+54550	

The Internal Rate of Return (IRR) for above plantation works out to be 26.58%. Beside above income of leaf fodder the trees can be harvested and wood can be used for packing cases, etc

iii) Commercial Cultivation of Safed Musli (*Chlorophytum* sp.)

In natural forests of Southern Aravallies, i.e., Udaipur, Sirohi, Banswara, Chittorgarh and Dungarpur districts in Rajasthan and adjoining areas of Banaskantha of Gujarat, this species is growing in wilderness. The dried roots of the herb possess vital medicinal values and is well-known for its aphrodisiac properties.

The plantation of this species can be grown in productive blank areas of natural forests or in good agriculture lands of Southern Aravallies. Fleshy roots

having shoot buds are collected during August-September from old areas. After drying in shade for 10-15 days, the propagules with buds are stored 15 cm under ground in shade for 7-8 months. After separating, the propagules along with roots are sown in nursery in June and irrigated till planting time. These fleshy roots are then planted in the ridges 30 cm apart and 15 cm in between 2 plants in a ridge. Within 3 to 4 months the plants are established from propagules. After October, the fleshy root bunches are dug out and cleaned with water and dried in a shady place and covered with jute bags. Tubers are turned every 2-4 days. Each tuber is then separated after 10-15 days. After peeling off the outer skin, the milky white tubers are washed and dried in open for 7-10 days and then dried and hard tubers are ready for sale. The average yield of root tubers is expected to be 1000 kg/ha. of green tuber, or 250 kg/ha. of dry tubers. For raising one hectare of plantation the likely expenditure is given below in a tabular form.

Sl No	Various heads of expenditure	Expenditure (Rs)
1	Collection of fleshy roots 250 kg for 1 ha @ Rs 10/kg	2500
2	Separating propagules with buds and maintaining each propagule as per calendar of work @ Rs 3/kg	750
3	Development of site - soil working - making of ridges	4000
4	Infrastructural shed for drainage irrigation facilities	8000
5	Protection	50
6	Digging of fleshy roots and processing	250
7	Miscellaneous and unforeseen including training	1450
Total		20000

iv) Bamboo (*Dendrocalamus strictus*) cultivation

This species has the distinction of being 'timber' for the rural poor as well as a cash crop in southern parts of Aravallie eco-system, especially in Udaipur, Chittorgarh, Banswara, Dungarpur and Sirohi districts of Rajasthan and Banaskantha area of Gujarat. Bamboo plantations are being raised in the forests under rainfed conditions and under Farm Forestry Programmes on agricultural lands in preference to *Eucalyptus* hybrid, either in Block Plantations or Strip Plantations along the Farm boundary at an espacement of 6x6 m, i.e., 270 plants/ha. At 80% survival 216 clumps/ha. will start giving exploitable bamboos from 6th year as given in the table below.

Year	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	onwards
New culms (No)	0	0	2	2	3	4	4	4	6	6	
Culm for exploitation (No)	0	0	0	0	0	4	4	4	6	6	

At 80% survival rate, 864 bamboos will be available from 216 clumps for exploitation from 6th to 8th year and 1200 bamboo per ha. per year @ Rs. 4/- per bamboo. The information is based on data of various farmers in Udaipur and Chittorgarh districts. The expected cash flow from bamboo plantations is given below in tabular form.

Year	Expenditure (Rs)	Returns (Rs)	Net (Rs)	Cash flow
1st	3900	-	- 3900	- 3900
2nd	1200	-	- 1200	- 5100
3rd	500	-	- 500	- 5600
4th	500	-	- 500	- 6100
5th	400	-	- 400	- 6500
6th	400	3456	+ 3056	- 3444
7th	400	3456	+ 3056	- 388
8th	400	3456	+ 3056	+ 2668
9th	400	5184	+ 4784	+ 7452
10th	400	5184	+ 4784	+12236
11th	400	5184	+ 4784	+17020
12th	400	5184	+ 4784	+21804
13th	400	5184	+ 4784	+26588
14th	400	5184	+ 4784	+31372
15th	400	5184	+ 4784	+36156
	10500	46656		

The I.R.R for Bamboo Plantations in Southern Aravallies works out to be 19.76%

Similarly the packages are also being implemented by cultivators and other organisations for the following species:

A) In Southern Aravallies

- 1 *Emblica officinalis* (Aonla) Plantations.
2. *Terminalia arjuna* (Arjun/Khoda) Plantations
3. *Anona squamosa* (Sitaphal) Plantations
- 4 *Rauvolfia serpentina* (Sarpagandha) Plantations
5. *Chlorophytum* spp (Safed Musli) Plantations
- 6 *Plumbago zeylanica* (Chitrak) Plantations.
- 7 *Wrightia tinctoria* (Khirni) Plantations

B) Northern and Central Aravallies

- 1 *Commiphora mukul* (Guggal) Plantations
- 2 *Erianthus munja* (Munj) Plantations on sandy deposits near Aravallies

3. *Lawsonia alba* (Mehndi) Plantations.
4. *Plantago ovata* (Isapgol) Plantations.
5. *Cassia auriculata* (Anwal) Plantations for Vegetable tannin

The Forest Department, Rajasthan is already implementing the 1,2,5,6 and 7 of (A) and 2, and 5 of (B) under various afforestation schemes. Still there are many packages available which can be provided to the individuals and organisations for implementation. *Urginea indica* (Jungli Kanda) can be another economic species, not only for its medicinal properties but for starch-yielding plant for textile industry.

CONCLUSION

Our future depends on the health and well-being of forests. For sustainable forestry one has to clearly choose priorities on various issues such as

- i) Understanding of the relationship between natural resources such as water, soil, forest and wildlife, the people and their livestock and their need of various forest produce of fuel, fodder, fibre, food, timber, medicinal and aesthetic values
- ii) Protection of biological diversity, i.e., preservation of plant and animal genetic resources and adoption of programmes for endangered plant and animal species
- iii) Inviting community participation in afforestation, protection and management of forest areas involving forest dwellers and people living in and around the periphery of the forest under Joint Forest Management. Developing special packages for rural/tribals using their indigenous knowledge in order to conserve resources and help people in achieving a sustainable livelihood
- iv) Establishing collaboration between Governmental Organisations, NGOs and User's Groups for supportive pilot projects to test promising approaches and mechanism. Increasing the sustained yield of various forest products to meet the rational demand of the present generation
- v) Replenishing the dwindling NTFP resources through adoption of proper methods of cultivations, harvest, grading, processing and storage, and collection of material of good quality duly supported by a system of collection of data of demand at State, National or International level and updating the system of passing this basic information of demand and its pricing, linked with incentives of grading, and
- vi) Strengthening Applied Research and Extension for augmenting the NTFPs production and sustainable multiple-use resource management

Various NTFPs are generally collected within limits of the quantities consumed locally, either singly or in groups, in an disorganised manner without any

definite studies on inventory, growth, productivity and the factors contributing to growth and development as well as unavailability of facilities for proper storage, transport and marketing.

The studies and documentation on the traditional knowledge of the people of various NTFPs for their health are also essential for the posterity.

In future, NTFPs are going to play an important role for socio-economic development of the rural poor and forest dwellers. Special packages for rural/tribals will have to be developed using their indigenous knowledge for sustainable livelihood, as well as community participation under Joint Forest Management. Implementation of useful packages for promotion of NTFPs by individuals, communities, organisations, co-operatives along with a proper back up of institutional support, value-addition and marketing facilities will protect and consolidate the biodiversity of the Aravallies eco-system for the future prosperity of the present and succeeding generations.

ANNEXURE-I

Sl No	Species	Local name	Family	NTFP Uses											
				Medi- cinal	Edible wild plants as food	Gums/ Oleo- resin	Veg Tannins	Organic colouring and Dye	Fodder and Forage	Fibre	Floss	Orna- mental/ Avenue	Oils	Beve- rages/ Alco- hols	Others
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	Tree Species														
1	<i>Acacia catechu</i>	Khair	Mimosaceae			+++									
2	<i>Acacia</i>	Kegar	Mimosaceae			++									
	<i>ferruginea</i>	Khair				++	++	++	+++	+++					
3	<i>Acacia</i>	Rongh	Mimosaceae			++	Bark	(Red) LVS							
	<i>leucophloea</i>							+ Bark							
4	<i>Acacia nilotica</i>	Babul	Mimosaceae			++++	++++		+++						
5	<i>Acacia senegal</i>	Kumtha	Mimosaceae		++++	+++									
6	<i>Aegle marmelos</i>	Bel	Rutaceae	++++	++++	++		+++							
7	<i>Alangium</i>	valvi- folium	Alangiaceae	+++	++ pulp	+		Yellow							Paper pulp
8	<i>Albizia lebbek</i>	Sims	Mimosaceae			++			++++						

(Contd)

Annexure-I (Contd)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
19	<i>Cordia dichotoma</i>	Lasoda	Ehretaceae		++++				++++	+++		+++			
20	<i>Commiphora mukul</i>	Guggal	Burseraceae	++++		++++			LVS	Bark					
21	<i>Dalbergia sissoo</i>	Shusham	Papilionaceae						++++			++++			Paper, Sapwood Paper pulp
22	<i>Diospyros melanoxylon</i>	Bel	Ebenaceae		++++		+++ Bark & Ft								Paper
23	<i>Emblica officinalis</i>	Aonla	Euphorbiaceae	++++	Ft Seed	++++	+++ Stem Bark								
24	<i>Ficus glomerata</i>	Gular	Moraceae		+++ Ft		+++ Bark								
25	<i>Ficus religiosa</i>	Pipal	Moraceae					+++ Bark LVS Root Red	++++			++++			
26	<i>Holoptelea integrifolia</i>	Churel	Ulmaceae							+++ Bark			+++ Fatty Oil Seed		
27	<i>Holarrhena antidysenterica</i>	Karai Dudhi	Apocynaceae	++++	+++						++ Ft				

(Contd)

Annexure-I (Contd)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
9	<i>Anogeissus pendula</i>	Kala dhokra	Combre-taceae			++			++++						
10	<i>Anogeissus latifolia</i>	Safed Dhav	"			++			++++						Paper & Rayon
11	<i>Annona squamosa</i>	Sitaphal	Annonaceae		++++										
12	<i>Azadirachta indica</i>	Nem	Melaceae	++++	+++	+++			+++			+++	++++		
13	<i>Balanites aegyptiaca</i>	Hingot	Simarou-biaceae	+++	Oil								Seed	+++	
4	<i>Bauhinia racemosa</i>	Kachar	Caesal-piniaceae		+++ (F1 buds)				+++	+++			Seed		
5	<i>Bombax ceiba</i>	Semal	Bomba-caceae	+++	+++ Paper pulp					Bark		+++ Ft	+++		
6	<i>Boswellia serrata</i>	Salar	Bursaceae	++		++++	+++								Paper pulp, Rayon
7	<i>Butea monosperma</i>	Palash	Paplon-acae			++++		++++	++	+++					Paper pulp
8	<i>Cassia fistula</i>	Amaltas	Caesal-piniaceae	+++	Pulp of Ft, Seed, Root bark		+++		Buffalo	Roots		+++			

(Contd)

Annexure-I (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
28	<i>Lannea coromandelica</i>	Godal	Anacardiaceae		+++ Young LVS	+++									Paper
29	<i>Madhuca indica</i>	Mahua	Sapotaceae		++++ Ft	+++ Ft						+++	+++ Fatty Oil	+++	
30	<i>Mangifera indica</i>	Am	Anacardiaceae		++++ Ft							++++	Seed kernel +++ Seed kernel		
31	<i>Mallotus philippensis</i>	Rohan	Euphorbiaceae					+++ Ft Red					+++	+++	
32	<i>Melia azedarach</i>	Bakam	Meliaceae	+++	+++								+++ Seed kernel		
33	<i>Moringa oleifera</i>	Senjana	Morngaceae	+++	++++ Green pods	+++		++ Wood-indigo				+++	+++ Seed		
34	<i>Phoenix sylvestris</i>	Khajoor	Palmaceae		++++									++++ (Neera)	Leaves for Broom, Mat, Basket
35	<i>Pongamia pinnata</i>	Karanj	Papilionaceae	+++	+++								++++		Paper pulp
36	<i>Pterocarpus marsupium</i>	Bijasal	Papilionaceae	+++		+++							Fatty oil		
37	<i>Schleichera oleosa</i>	Kusum	Sapindaceae	+++									+++		Ft & Oils

(Contd.)

Annexure-I (Contd)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
38	<i>Sterculia urens</i>	Karaya	Sterculiaceae			+++				+++					Rayon grade pulp
39	<i>Syzgium cumini</i>	Jammu	Myrtaceae	++++ Ft	+++ Ft			+++ Red	+++ Bark	+++ Leaves, Seed					
40	<i>Tamarix aphylla</i>	Farash	Tamaricaceae				+++ on branches								
41	<i>Tamarindus indica</i>	Imli	Caesalpiniaceae		+++ Pod		+++ Bark 7%	Bark Brown							
42	<i>Terminalia arjuna</i>	Kohedis	Combretaceae				+++ Bark 17%	++							
43	<i>Terminalia bellirica</i>	Baheda	Combretaceae	++++			+++ Bark 15%	+++					+++ Oil Seed		
44	<i>Terminalia tomentosa</i>	Sadar	Combretaceae				+++	+++ Bark Brown							
45	<i>Wrightia tinctoria</i>	Khurni	Apocynaceae	+++				+++ Ft, Orange Seed, Ycl- low Roots			+++		+++ Oil Seed		Wooden toys
46	<i>Wrightia tomentosa</i>	Kherna	Apocynaceae	+++ Seed	+++ oil	++ LVS Ft							+++ oilseed		
47	<i>Ziziphus mauritiana</i>	Ber		+++Ft						+++					

(Contd)

Annexure-I (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
B	Shrub Species														
1	<i>Achyranthes aspera</i>	Kantu	Amaranthaceae	+++ Seed											
2	<i>Adhatoda vasica</i>	Adusa	Acanthaceae	++++LVS				+++ Yellow							
3	<i>Cassia auriculata</i>	Anwal	Caesalpiniaceae		+++ Fl		++++								
4	<i>Capparis decidua</i>	Ker	Capparidaceae		+ Buds										
					++++Ft										
					+ Ft										
5	<i>Carissa carandas</i>	Karaunda	Apocynaceae		++++Ft										
6	<i>Calotropis procera</i>	Aak	Asclepiadaceae	++++											
7	<i>Centella asiatica</i>	Brahmi	Umbelliferae	++++											
8	<i>Chlorophytum</i> spp	Safed musli	Liliaceae	+++	++++ Ro-										
					ots/LVS										
9	<i>Citrus medica</i>	Neembu	Rutaceae		++++Ft										
10	<i>Crotalaria burhia</i>	Khump	Papilionaceae							++++					
										(Stem)					
11	<i>Euphorbia nivulia</i>	Thor	Euphorbiaceae	+++LVS											
				, + Juice											
12	<i>Grewia tenax</i>	Gangren	Tiliaceae		+++ Ft										
13	<i>Indigofera tinctoria</i>	Neel	Papilionaceae												
								+++ LVS +							
								Fl Blue							
14	<i>Jatropha curcus</i>	Ratanjot	Euphorbiaceae	+++										++	
15	<i>Leptadenia pyrotechnica</i>	Khump	Asclepiaceae		++++ Ft									+++	
					+ Young									Kernel	
					twigs										

(Contd.)

Annexure-I (Contd)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
16	<i>Ocimum sanctum</i>	Tulsi	Labiatae	++++											
17	<i>Pandanus tectorius</i>	Kewra	Pandanaceae							+++		+++	+++		
18	<i>Plumbago zeylenica</i>	Chitrak	Plumbaginaceae	++++									Essen oil		
19	<i>Rhus mysurensi</i>	Dasran	Anacardiaceae		++++ Ft										
20	<i>Salvadora oleoides</i>	Peelu	Salvadoraceae	++++Ft	++++ Fr										
21	<i>Salvadora persica</i>	Jal	Salvadoraceae												
22	<i>Solanum nigrum</i>	Maakoi	Solanaceae	++++											
23	<i>Tinospora cordifolia</i>	Giloi	Menispermaceae	LVS ++++											
24	<i>Tribulus terrestris</i>	Gokhru	Zygophyllaceae	++++											
25	<i>Vitex negundu</i>	Negad	Verbenaceae	Dashmul ++++											
26	<i>Ziziphus nummularia</i>	Jharben	Rhamnaceae	++++ Ft		+++ Bark									

(Contd)

Annexure-I (Contd)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
C	Herbs & Grasses & Bamboos														
1	<i>Asparagus-racemosus</i>	(C) Satawari	Liliaceae	++++	+++										
2	<i>Boerhavia diffusa</i>	(H) Punernava	Nyctaginaceae	+++ (for kidney)											
3	<i>Cenchrus ciliaris</i>	(G) Safed Dhaman	Gramineae						++++						
4	<i>Cenchrus-setigerus</i>	(G) Kala Dhaman	Gramineae						++++						
5	<i>Cuculus lanatus</i>	(H) Tarbuz Indrayan	Cucurbitaceae	+++											
6	<i>Datura stramonium</i>	(H) Dhatura	Solanaceae	+++											
7	<i>Dendrocalamus strictus</i>	(G) Bans	Gramineae		+++										
8	<i>D. chanithum annulatum</i>	(G)	Gramineae						+++						
9	<i>Erianthus munja</i>	(G)	Gramineae							+++ Upper leaf sheath					

(Contd)

Annexure-I (Contd)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
10	<i>Heteropogon contortus</i>	(G) Soorwal	Gramineae						+++	++++					
11	<i>Panicum antidotale</i>	(G)	Gramineae		++++				++++						
12	<i>Setaria glauca</i>	(G)	Gramineae						+++						

+++++ = Profusely used
 +++ = Commonly used
 ++ = Occasionally used
 + = Seldom

LVS = Leaves
 Ft = Fruit
 Fl = Flowers

C = Climber
 H = Herb
 G = Grass

Biological Upgradation of Trans-Himalayan Ladakh

C.M. Seth

INTRODUCTION

Ladakh, India's northern-most territory, constitutes the highest geographical division of Jammu & Kashmir State. Total area of the state at present is 1,38,942 sq. kms, out of which Ladakh constitutes 58,036 sq. kms, shorn of the areas under illegal occupation of China and Pakistan

The territory of Ladakh is one of the most elevated regions of the earth. The different valleys lie along the headwaters of the Indus, Shyok, Nubra, Zaskar, Suru and Drass. The joint effect of elevation and of isolation amidst snowy mountains produces perhaps the singular climate in the world.

The climate of Ladakh is characterized by great extremes of heat and cold and by excessive dryness. During the day time in general the temperature may go up to 25°C, sometimes up to 28°C and rarely up to 35°C. While during winters, the minimum temperature during night may touch -6°C and even go down to -40°C, as reported at Drass.

Towards the mid-day, the lower strata of the atmosphere becomes rapidly heated and the rarefied air moves as the day advances, the current of air quickly increases in strength until it becomes a high wind which blows steadily during the afternoon with occasional gusts of great violence. Monsoons do not reach Ladakh.

The water which is vapourized, gets condensed and returns in the form of rain or rather a drizzle. The quantity of rain that falls in Ladakh is exceedingly low.

The myth that Ladakh is a tree-less country, right from the beginning is not totally true, but it seems that due to continuous exploitations of the resources by locals for fire-wood and other purposes, a tree-less situation has been created. Experience shows that with little efforts the fragile eco-system of Ladakh can be biologically upgraded by recreating forests, pastures, etc., on most of the barren areas.

Vegetation is found on very fragile mountain slopes in Ladakh. In the past, locals, Lamas of monasteries, merchants, etc., all have added to the removal of vegetation but little efforts were made to replenish the same. Hence, everywhere

the landscape gives a look of barrenness, particularly around monasteries and villages located at a distance from the main rivers.

THE NATURAL FORESTS

Practically and legally speaking, there are no forests areas in Ladakh, as most of the lands are either owned by Monasteries or belong to village community as Village Common Lands. The Government books record only 0.02% forest area in Ladakh as compared to 45.83% in temperate Kashmir and 50.88% in sub-tropical Jammu. But from vegetation point of view Ladakh possesses three main types of floristics (Stewart, 1917, Kachroo *et al.*, 1977). The alpine vegetation is confined to higher altitudes where glacier irrigation is available. Main portion of Ladakh's landscape is covered by desertic vegetation. The oasitic type is commonly found along river beds of Suru, Indus, Nubra and other small hill tributaries. Desertic vegetation is mainly confined to drier hill slopes. The oasitic type of vegetation comprises of *Populus*, *Salix*, *Myricaria*, *Hippophae*, *Tamarix*, *Elaeagnus* species. The desertic elements are represented by species of *Lonicera*, *Echinops*, etc. Alpine vegetation, mainly comprises of perennial grasses, *Saussurea*, *Gentianella*, *Kobresia*, *Rheum* and such components as represented by *Juniperus*, *Cotoneaster*, *Rosa* and alpine *Salix*, etc.

REHABILITATION EFFORTS IN LADAKH

The oldest recorded history of man-made forests in this region is about 70 years old. It was in the time of Mehta Mangal Das—the then Wazir Wazarat of Ladakh, who realising the significance of plantations, started these efforts (Koul, 1992). These plantations were locally termed as 'poplar gardens' or 'Bag'. These gardens, in total, extended over an area of 100 ha. and the size of gardens varied from 0.4 hectares to even individual tree garden in the backyard, locally called as *Chargna Chick*. Few plantations were encouraged near monasteries and mosques so as to meet the requirements of fire-wood for these religious places. These gardens, subsequently, were cut ruthlessly in 1947 to meet the requirements of army garrisons. Till 1955-56, these gardens were managed by revenue departments and in 1955, were transferred to the Forest Department. Before 1955, the tree cover of Ladakh had almost become barren and tree-less. The villagers were facing great hardships in procuring fire-wood and timber for their households. To mitigate the hardships of people of Ladakh, the Forest Department adopted a two-pronged approach:

1. Raising plantations of fast growing tree spp
2. Supplementing fodder and fire-wood supplies from outside

In order to supplement the fire-wood requirement, Forest Department imported timber and fire-wood from Kashmir valley at a very exorbitant cost. In mid 1980's only 1400 m³ of timber, 90,000 kg of fire-wood and 90,000 kg of

hardcoke were imported on an annual basis from Kashmir and other places of the country. Meanwhile to meet the local requirement, government also started various schemes to encourage plantation of fast growing tree species around villages and slowly reduced the supplies from outside. With this idea of bringing more and more areas in Ladakh under vegetative cover and arresting desertic conditions, Frontier Division in Ladakh of J&K Forest Department was created in 1955. Its main function was to conserve wildlife, raise plantations and control MFP extraction. Initially, the plantation work was taken up near villages and along river banks where irrigation was available. The species selected for the purpose were poplars and willows because they have fast rate of growth and also being in the natural habitat. Some other species selected from Kashmir Valley were exotic in nature but their results were very encouraging. Till 1967-68, most of the plantations were raised on unirrigated wastelands but with a high mortality. Later on, plantations were raised along river banks or wherever irrigation was available on the village common lands. The choice of species was *Populus candicans*, *P. euphratica* and *P. nigra*. In Nubra, mainly *P. euphratica* was planted. Near Chushul and Leh, along the river Indus, *P. nigra* and *P. candicans* were preferred. As the performance of these species in rehabilitation and afforestation of eastern Ladakh was very encouraging, the Ladakh Forest Division was bifurcated into two divisions as Leh and Kargil in 1979-80. This reorganized set-up of the Forest-Department gave a big boost to plantation of tree species, in both Leh and the Kargil districts. Biological upgradation of Ladakh thus does not require any justification. In order to bring maximum areas under tree-plantations, a multipronged approach has been adopted, at present through District plan schemes as well as special Desert Development Projects. Besides plantation, thrust is being given to soil conservation and pasture-development works. At present, various schemes that have been undertaken are

Village Wood Lots

Under this scheme, plantations are raised on villages community lands where irrigation is ensured. In this scheme, 90% investment is made by the Government and 10% by the village beneficiary.

Private Plantations

Private individuals are encouraged to raise plantations on their proprietary wastelands, where irrigation is available. This scheme provides 66% subsidy.

Sand Dune Stabilization

The river valleys were once rich with oasic type of forests, but due to



Fig. 1: Zaskar Valley, 18000', Rich in Medicinal Plants



Fig. 2. Zaskar Valley, 18000', Rich in Medicinal Plants

uncontrolled exploitation over the centuries, huge tracts have become barren and deserts. The Nubra Valley is a typical example of this phenomenon, especially the vast stretches along river Shyok, where sand dune formation has threatened the adjoining villages also. So in 1986-87, a new scheme of sand dune stabilization was taken up by the Forest Department. The species selected for the stabilization purpose was none other than the indigenous *Hippophae*. This species possesses all the characteristics required for stabilization due to the presence of root suckers, root nodules and a bushy nature. In 1994-95, 2 50 lac *Hippophae* plants have been planted to cover an area of about 20 ha.

Closure of Degraded Forests

The natural forests which are in a highly degraded condition are being closed under the scheme so as to protect them from biotic interference. This scheme is mainly for Nubra and Changthang areas.

Improvement of Degraded Pasture Lands

In Changthang, the herds of Yak and flocks of Pashmina Goat of nomadic Changpas face an acute shortage of fodder due to the low productivity of pasture lands. Scheme is envisaged to provide irrigation from natural glaciers and if possible, improve pastures with the sowing of high-yielding varieties of grasses and legumes.

Cultivated Fodder

This scheme is for community and pasture lands outside agriculture lands where little irrigation is available. Mainly Yarkandi oat is grown which provides both greens as well as dry fodder.

Following Table indicates progress of plantation since 1955 in Ladakh

Year	Area (ha)	No of plants (in lac)
1955 to 79-80	2514 28	59 33 (Ladakh)
80-81 to 92-93	386 4	18 76 (Leh only)
93-94	40 00	1 07 (Leh only)
94-95	214 30	9 20
93-94	168 00	7 58 (Kargil District only)
94-95	66 00	3 00 (Kargil District only)
Total	3386 98	98 94



Fig. 3: *Prangos pabularia* Lindley, Hay collected for winter fodder in Dras (Ladakh), 12000'. Fruit of plant possesses medicinal value

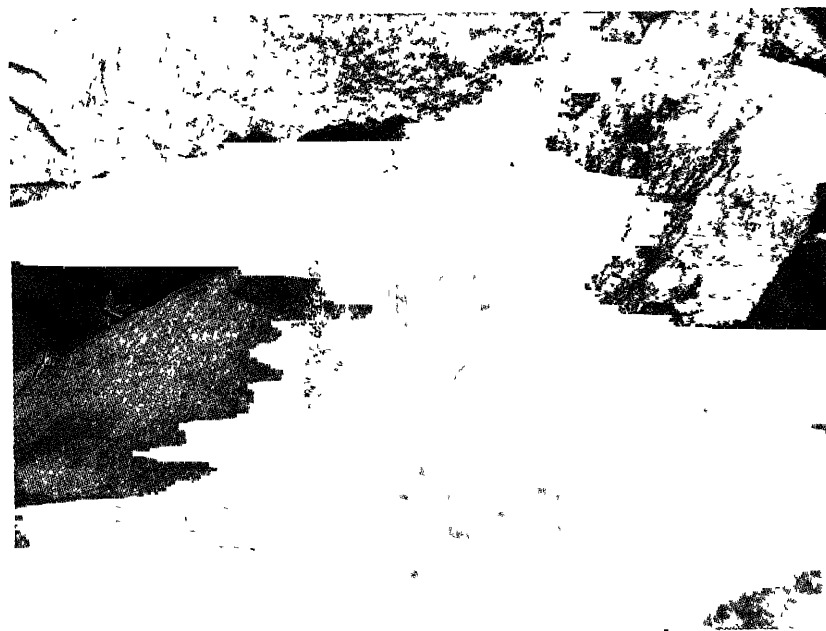


Fig. 4: *Oxyria digyna* (Linn) Hill, Plant commonly found at higher altitudes of Kashmir Himalayas, used to cure blood haemorrhage

FURTHER TRIALS

In 1991-92, Working Plan and Research Circle started trials of growing exotic willows in Ladakh.

Cutting of seven species of willows were collected from the Regional Research Laboratory, Jammu. The species were *Salix humboldtiana*, *S. salamonii*, *S. celerodendron*, *S. smuthiana*, *S. alba*, *S. mucronata* and *S. cinerea*. These species were also tried in other parts of the state. Trials in Ladakh were carried out in Kargil, Leh and Nubra. Trials of 91-92 failed but of 92-93 gave good results in Leh. Out of all species, *S. humboldtiana*, *S. salamonii* and *S. cinerea* gave encouraging results in the nursery. Field trials have not been taken up so far.

Although *Robinia pseudoacacia* plantation is doing well in Gopuk nursery at Leh, large scale plantations in wastelands, agricultural lands have not been taken up. This needs to be encouraged in field plantations along with poplar and willow.

Some of the Non-Government Organizations like LEDEG and Leh Nutrition, etc., have taken up plantations of *P. casale* and *P. deltoides*. Initial results of growth are quite encouraging.

Forest department has also taken up mixed plantation of willows and *Hippophae* along river banks and other irrigated areas.

In villages, people have adopted another eco-compatible model of plantations. The outermost boundary of two to three rows is of *Hippophae*, which besides acting as a live hedge also acts as a soil binder. This row is followed by two and three rows of poplars and willows. Poplars and willows supply timber for construction and leaves of willow provide green fodder to livestock. Between the agricultural fields and poplar rows about 50' to 100' belt is planted with lucerne, oat and other green fodder species. This fodder is not grazed upon but is allowed to grow till September, when it is cut, made into bundles and stored on rooftops to be used as hay in winter. The bank of nalla is again planted with *Hippophae*, willows and poplars, protecting agricultural fields from erosion. This is an ideal model of Agroforestry which needs replication in all the villages of Ladakh for sustainable bio-upgradation and development of fragile and unproductive lands.

Other options available for the bio-upgradation of Ladakh is to popularize the cultivation of medicinal plants on the lands which are not put to any use at present. The medicinal plants are in great demand in the Tibetan System of Medicine and other Pharmaceutical industry of India. More than 1000 plant species are being used by local Amchies for treatment of various kinds of diseases. These plant species should be grown on a large scale where depletion has occurred due to grazing (Srivastava, *et al*, 1982). Cultivation of improved



Fig. 5: *Heracleum candicans* Wall. ex DC, Pushpanjal mountain range, Kashmir Himalays' 10000'. Plant is extensively used in medicines for curing cancer, cuts & wounds

cultivars of *Hippophae* from Russia and China is another alternative which needs to be explored.

DEVELOPMENT OF FORAGE

Ladakh faces an acute shortage of fodder for its domestic animals, which in turn affects the milk and meat production, the two main factors which constitute the backbone of sustenance economy. At present, efforts are being made to increase fodder production from government and non-government lands. In the private sector, main emphasis is being laid on the cultivation of alfa-alfa. Two varieties

grow in agricultural fields. The yellow flowered is *Medicago falcata* and blue flowered is *Medicago sativa*. Since *M. sativa* is the comparatively higher yielder, SKUAST scientists are making efforts to increase its productivity by selecting high yielding strains. The yield have been reported to range from 52.85 qtls./acre to 98.73 qtls /acre in dry form

To meet the requirements of seed, more and more seed farms are being established. About 5000 ha have been covered under fodder crops in Ladakh District.

In community grazing lands, controlled grazing is being introduced in pastures planted with one legume and two grass species. The combination has yielded following out put.

Species	Green Fodder Yield/Acre	Dry Fodder Yield/Acre
Legume		
<i>Lotus corniculatus</i>	56.83 qtls	20.45 qtls
Grasses		
<i>Dactylis glomerata</i>	51.14 qtls	17.90 qtls
<i>Festuca pratensis</i>	34.09 qtls	17.84 qtls

Source: Prem Singh Jina, 1995

In addition to above, great stress is being laid on multicut-fodder crop cultivation. Most favoured species for this purpose is oat. Two to three cuts are obtained of this crop to meet forage requirement of milch animals. The practice is becoming very popular among villagers of Ladakh. In Drass, efforts are afoot to bring more and more area under cultivation of *Prangos pabularia*, used as Hay in winter. Most of the hill slopes are being brought under its cultivation. So far, 200 ha has been covered.

CONCLUSION

In earlier times, Ladakh's economy was based on the trade between central Asian countries and the Indian sub-continent. Very little emphasis was laid on agriculture production and conservation of fire-wood and fodder resources. Due to re-orientation of geo-political boundaries and stoppage of trade routes, the economy of Ladakhis became one of sustenance. Since the area was blessed with big land mass and natural water resources, efforts were initiated in the last forty years to biologically upgrade the fragile ecosystem and change the economy of Ladakh's from sustenance to sustainable. Lately, however the traditional Ladakhis are changing their priorities towards the upcoming tourism industry but the ultimate solution lies only in bringing more and more areas under forest, pasture, agriculture and other biological production systems.

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A Note on Survival of Some NTFP Plants from North-western Ghats

Archana Godbole

INTRODUCTION

Collection and sale of NTFP plants form a major economic activity around the majority of forest areas. Many NTFP items possess the potential of raising economic status of the people, especially the tribals residing around the forests. It is estimated that NTFP collection, processing and marketing can generate a gainful employment to thousands of people every year.

For years, tribals are using various commodities like food, medicine, fibre, fodder, honey, etc., derived from plants, readily available from the forests. The products obtained from them are called minor forest produce (MFP). However, people using these plants as well as forest department never bothered about their sustainable use or cultivation.

Due to increasing population pressure, forests are being depleted increasingly at higher rates. Forests are mainly exploited for low quality locally available timber and fuel-wood. Some developmental activities like hydro-electric projects, dams, mining, road construction have also contributed to this depletion. In late seventies, it was realized that forest depletion has definite effect on survival of various NTFP plants. North-western Ghats are no exception. Therefore, it was thought necessary to assess some of the NTFP plants from North-western Ghats. A preliminary study has been conducted in representative areas from North-western Ghats with following objective:

- i) to find out the present status of NTFP plants from North-western Ghats
- ii) to study the effects of forest depletion on survival of selected NTFP plants, and
- iii) to study the regeneration status of these NTFP plants

AREA UNDER STUDY

The Western Ghats occur as an almost unbroken chain along the western fringe of Peninsular India. There are about 4 zones from the northern most part near the river Tapi to the southern most within the sight of Kanyakumari. The first and northern most zone extends from Tapi to Sindhudurg District of Maharashtra, nearing Goa border. This zone is considered as North-western Ghats.

Four major forest types occur in the North-western Ghats depending upon the altitude and rainfall, viz., Dry-deciduous, Moist-deciduous, Semi-evergreen and Evergreen forests. These forests harbour diverse plant species and many of them are used as NTFP. Areas with reasonable forests like Ambavne, Amboli, Bhimashankar, Bhor, Khandala, Koyanagar and Mahabaleshwar have been selected for a detailed study. Tribals and other local people collect NTFPs from the forests around these areas. Some of these items are used locally but a very few have been exploited commercially on a large scale.

METHODOLOGY

To achieve the above objective, data has been collected on following lines

- i) village structure, locality and ethnic composition,
- ii) surrounding forest area and its status,
- iii) NTFP plants and their use, and
- iv) regeneration of NTFP plants and factors affecting it.

Through general survey of local markets and selected villages, a list of plants used as NTFPs has been prepared. List of dominant NTFP species for each selected area has also been prepared. Regeneration status of some selected species like *Adhatoda vasica*, *Elaeagnus conferta*, *Phyllanthus emblica*, *Mappia foetida* and *Terminalia chebula* has been estimated by using simple ecological methods. At the same time factors affecting natural regeneration like grazing, cutting for fuel-wood, forest fires, etc., have also been studied by using simple parameters.

RESULTS

It has been found that 219 plant species are used as NTFP plants in the North-western Ghats. Out of these, 163 plants are used on a very localized scale. These plants include *Arisaema murrayi*, *Atalantia racemosa*, *Allophylus serratus*, *Barleria prattensis*, *Celastrus paniculata*, etc. Even though these plants are used on household level, they have a definite role in household economy. Most of them are used as seasonal vegetables, fruits and medicines. About 46 species are used as food, medicine, fibre, etc., and have place in the local trade. These NTFP species include *Curcuma pseudo-montana*, *Entada pursaetha*, *Elaeagnus conferta*, *Cayratia lanceolaria*, *Dioscoria oppositifolia*, *Clerodendrum serratum*, *Ensete superbum* and *Ziziphus rugosa*. Remaining 10 NTFP species are collected from the forests on a very large scale and are very important in NTFP trade and commerce. Areas of collection, use and market for these 10 species is given in Table-1. During the study it was repeatedly conveyed by the tribals that availability of NTFP plants in the vicinity of village forest is decreasing and time spent for their collection is increasing day by day.

Table-1

Sl No	Name of the Plant	Area of collection	Use	Market
1	<i>Adhatoda vasica</i>	Ambavane, Bhore, Khandala	Medicine	Local, Ayurvedic companies
2	<i>Carissa congesta</i>	All over the NWG	Food, Medicine	Local, cities
3	<i>Careya arborea</i>	All over the NWG	Household, agricultural	Local, horticultural zones
4	<i>Cordia myxa</i>	Amba, Bhore, Khandala	Food	Local
5	<i>Madhuca latifolia</i>	Amba, Bhore, Khandala	Food, medicine	Local
6	<i>Mangifera indica</i>	All over the NWG	Food	Local, cities
7	<i>Mappia foetida</i>	Amboli, Bhore, Koyana, Mahabaleshwar	Medicine	Export
8	<i>Syzygium cumini</i>	All over the NWG	Food, medicine	Local, cities
9	<i>T. bellirica</i>	Ambavane, Khandala, Koyana	Medicine	Ayurvedic companies
10	<i>Terminalia chebula</i>	Amba, Amboli, Bhore, Bhimashankar	Medicine, tannin	Ayurvedic companies

REGENERATION STATUS

Regeneration status is dependent upon the number of plants per unit area and disturbance to the germinated seeds and very small seedlings. Number of germinated seeds/small seedlings and number of well established seedlings for selected NTFP plants per unit area is given in Table-2

Table-2

Sl No	Name of the Plant	No of germinated seeds/1000 sq ft	No of established seedlings/1000 sq ft
1	<i>Adhatoda vasica</i>	69	14
2	<i>Elaeagnus conferta</i>	23	5
3,	<i>Mappia foetida</i>	629	18
4	<i>Phyllanthus emblica</i>	22	9
5	<i>Terminalia bellirica</i>	32	6
6	<i>Terminalia chebula</i>	23	2

DISCUSSION

North-western Ghats were thickly wooded fifty years ago. The diverse, luxuriant vegetation has been continuously subjected to exploitation and the forest acreage has shrunk drastically. Vegetation pattern and ecological conditions in the North-western Ghats have changed rapidly within last two decades. So far it was thought that NTFP plants are easily available from the forests and their

natural regeneration is also compatible. But due to factors like overgrazing, habitat destruction, forest fires, natural regeneration percentage has gone down drastically within the last 10-15 years. Similarly, due to non-systematic collection practices, use of these items on a sustainable basis is not possible.

Certain plants like *Dioscoria oppositifolia*, *Ceropegia lawii*, *Pueraria tuberosa* have been extensively collected for edible tubers. Now these plants have become scarce. While collecting these tubers, the whole plants are pulled out without giving a chance for natural regeneration through suckers, rhizomes, etc.

Habitat destruction is another major influencing factor for the failure of natural regeneration of various NTFP plants. Some giant woody climbers like *Dalbergia sympathetica* and *Entada pursaetha* grow in the crowns of tall trees like *Mangifera indica*, *Sterculia guttata*, *Terminalia chebula*, etc., in thick moist forests. When these large shady trees are cut out for timber, naturally the climbers could not survive and are thus lost.

It is important to note particular plant associations and their interdependence for survival. Plants like *Vigna vexillata*, *Hemidesmus indicus*, *Mucuna pruriens*, *Mappia foetida* are always found growing inside the thick shrub clumps composed of shrubs like *Carissa congesta*, *Lantana camara*, *Osyris quadripartita* and *Vitex negundo*. When seeds of *Hemidesmus indicus*, *Vigna vexillata*, etc., are formed, they fall within the limits of shrub clumps and are naturally protected in the seedling stage. Such thick shrub clumps are always cut from all sides for fuel-wood, day by day reducing their size. Survival of plants like *Hemidesmus*, *Vigna* and *Mucuna* is in danger due to such activities.

Uncontrolled grazing and shifting cultivation practices in the hilly areas are also responsible for depletion of NTFP species. Shifting cultivation is a very common practice in North-Western Ghats. Some decades ago human population was limited and forest cover was more. Due to increasing population pressure and decreasing forest cover, shifting cultivation cycle is reduced to just one or two years. Ultimately there is no scope for natural regeneration and many NTFP species are steadily depleting from particular areas. Similarly there is tremendous increase in freely grazing cattle all over the North-western Ghats. Cattle always trample the young seedlings thereby restricting surviving number of plants like *Terminalia chebula*, *Peucedanum grande*, *Albizia procera*, *Madhuca latifolia*, etc.

Some herbaceous NTFP plants like *Peucedanum grande*, *Oldenlandia corymbosa*, *Adhatoda vasica* are destroyed due to vigorous forest fires, purposely lightened by the villagers on hill slopes for burning grass with a belief that it enhances grass growth in the next season.

Mappia foetida is not the traditional NTFP species, but due to its over-exploitation for export purposes, the population of this plant is vanishing from many areas. Many NTFP plants are facing problems for their survival around

several tourist centres, e g , flowers, twigs and bulbs/rhizomes of plants like *Gloriosa superba*, *Curcuma pseudo-montana*, *Usnea barbata*. Some polyporus and bracket mushrooms are also collected and sold as decoration items. Increasing demand from tourists for such items has led to their over-exploitation and scarcity. Some of these plants have also become scarce from certain areas like Khandala, Mahabaleshwar, Panchgani which are major hill stations.

Cultivation of NTFP plants has been tried in case of certain species like *Syzygium cumini*, *Adhatoda vasica*, *Mappia foetida*, but not popularized and practiced on a large scale.

Wild fruits like *Carissa congesta*, *Cordia myxa*, *Elaeagnus conferta* and *Ziziphus rugosa* are sold in local markets but their value-added products like pickles and jams have been tried only in case of *Carissa congesta* and *Cordia myxa*. These plants are readily available, but storage in fresh forms is quite difficult. Research and trials are necessary for NTFP plants like *Elaeagnus conferta*, and *Ziziphus rugosa* to increase their commercial value and preservation. Selection of better varieties of these fruits from wild varieties is also important to enhance their commercial value,

CONCLUSION

NTFP plants are very important as far as the local economy is concerned. Some of these species are important in commerce and trade. The major causes for the depletion and low percentage of survival of these valuable resource species are:

- i) forest depletion for timber, fuel-wood and developmental activities,
 - ii) habitat destruction and forest fires,
 - iii) uncontrolled grazing and shifting cultivation,
 - iv) unsystematic collection practice, and
 - v) cultivation techniques are not known properly in most of the cases.
- Survival of these NTFP species can be improved and increased by
- i) developing suitable cultivation practices,
 - ii) collecting naturally established seedlings from the wild and planting them elsewhere in the similar habitats,
 - iii) using these species for wasteland development and augmentation of established social forestry plantations,
 - iv) protecting habitats and peculiar plant associations,
 - v) developing methods for sustainable use and collection, and
 - vi) developing value-added products from NTFP species thereby increasing their value in commerce.

To achieve this survival and protection of NTFP plants, involvement of local people, especially tribals is most important at every step.

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Rattan of North-east India and Strategies for Their Conservation

D.K. Hore

INTRODUCTION

Rattans denote the term, the long thin pliable stem of various species of East Indian climbing palms of the genus *Calamus*. To have an elaborate and better understanding, some related genera of similar habitat have also been included in this account. This includes the genera like *Daemonorops*, and *Plectocomia*. All these genera belong to the Family Arecaceae (Palmae). From the utilisation point of view, stems are important. The reed-like stem with long internodes have usually trailing/climbing habit. The stem is often covered with the remains of old leaf-sheaths, or is thorny. The height/length may reach 120-150 m in some species and it grows slowly in thickness.

The North-eastern region of India comprise of 8 states if Assam is included within it. The total geographical area is 242195 sq. km and the total forested area is 129658 sq.km. About 53.53% area is still covered with forests. The topographical feature is undulated and hilly in nature barring the plains of Barak and Brahmaputra Valley. Thus, there is varied nature of altitude (65-7100 m), rainfall (300-12000 mm) and temperature (Min. 2°C to Max. 36°C) according to location.

The tropical to temperate, sub-tropical forested area of the region harbours Rattan according to their favourable ecology and habitats. The identification status of the species under different genera of Rattan reveals that there are 15 taxa of *Calamus*, 1 species of *Daemonorops* and 3 species of *Plectocomia* which occur in this region. However, the populations of the species is not yet ascertained.

In the present account, the occurrence of Rattan species, their diversities, taxonomy, diagnostic features, usefulness, distribution and strategies for conservation have been discussed and envisaged.

RATTAN OF NORTH-EAST INDIA

Calamus L.

There are 375 species of *Calamus* which are palaeotropical in distribution.

Tropical forests are the habitat for majority of species where some species run a length of 120-150 m. So far only 15 taxa belonging to 13 species of this genus have been reported from NE Region of India.

- 1 *Calamus acanthospathus* Griff. in Calcutta J Nat. Hist 5 : 39 1845. *C montanus* T. And in J Linn Soc. 11 : 9 1869

Slender, scandent rattan, internode length 5 cm, diam 2-2.5 cm, fruit ca 12 mm in diam., obovoid or globose, beaked, scales chestnut brown, obscurely channelled, shining.

The species grows in the Himalayan belt, ascending up to 1800 m altitude
Distrib Sikkim, Meghalaya

- 2 *Calamus erectus* Roxb, Fl. Ind 3 774 1832, Becc. & Hook f in Hook f, Fl. Brit India 6 438 1892 (excl. *C schizospathus*)

Erect cane, stem 5-6 m long, internodes 6-8 cm apart, diameter 2 to 2.25 cm, fruit ca. 3 cm long, ovoid-oblong; scales trapezoid, dark brown with a yellow base.

The species is adapted in tropical to sub-tropical conditions of the region and ascending up to 1200 m altitude

Distrib. Arunachal Pradesh ('Jeng'), Assam, Meghalaya and Manipur

Uses The ripe fruit used as substitute for betel-nut

3. *Calamus flagellum* Griff in Mart., Hist Nat Palm. 333 t 176, f 9 1849, Becc. & Hook.f in Hook f, Fl Brit India 6 439 1892

Robust cane but at length becomes scandent, diam ca 3-4 cm Fruit 3 x 2 cm, ovoid oblong, cuspidately beaked, scales deeply furrowed, pale with a dark band down the middle

The species confined to sub-tropical zone of hill forests ascending up to 1200 m

Distrib Sikkim, Assam, Nagaland ('Nagagola' bet), Meghalaya, Mizoram, Arunachal Pradesh (local name - 'Raidang')

4. *Calamus floribundus* Griff in Calcutta J Nat Hist 5 56. 1845 & Palms Brit India 66, t 197 1850, Becc & Hook.f. in Hook.f. Fl Brit India 6 444 1893

C mishmeensis Griff in Calcutta J Nat Hist 5 55 1845

The cane is usually 2 cm diam ; fruits globose, shortly beaked, 1.5 cm diam , scales very pale yellow, channelled down the back

It occurs in Assam, Meghalaya and Arunachal Pradesh at altitude between 900-1200m ('Lejai')

5. *Calamus floribundus* var. *depauperatus* Becc
It occurs sparsely in different localities of North-east India.
6. *Calamus gracilis* Roxb. Fl. Ind. 3 : 781 1832; Becc. & Hook f in Hook f., Fl. Brit India 6 : 453 1893
Stem naked, slender, scandent, fruit oblong, ca. 2 cm long; scales very pale, ripe, channelled, seeds wrinkled
It grows from tropical to sub-tropical forested area up to 1200 m altitude of Assam ('Hundi' bet), Meghalaya and Mizoram ('Lehai').
7. *Calamus guruba* Buch -Ham in Mart., Hist Nat. Palm 206, 211, 330, t. 175, f 1. 1849; Becc. & Hook.f. in Hook.f., Fl Brit. India 6: 449. 1893
C. mastersianus Griff. in Calcutta J. Nat. Hist. 5: 76. 1845.
Tall, scandent cane, stem without any sheath, comparatively thin, of ca. 1.5 cm diam ; fruit pisiform, apiculate, less than 1 cm diam., abruptly beaked; scales pale, obscurely channelled, margin brown.
The habitat of the species is between tropical to sub-tropical (500-1000m) belt of the region It is found in Assam, Meghalaya, Arunachal Pradesh and Tripura and locally known as 'Sundi' bet.
8. *Calamus inermis* T And. in J. Linn. Soc. Bot 11. 11.1869.
C. laurifolius sensu Becc. & Hook.f. in Hook f. Brit. India 6 455 1893 (*proparte non* Roxb., 1832).
Short, stout stem (80 cm) with 2-2.5 cm in diam.
The species is distributed in lower elevations which hardly ascend up to 800 m in Sikkim and Assam State.
9. *Calamus khasianus* Becc. in Ann Roy Bot Gard Calcutta 11 80, 431.1908.
Poorly known species
The species is limited within 1000 m altitude in Meghalaya
10. *Calamus kingianus* Becc in Ann Roy. Bot Gard. Calcutta 11 197. 1908
Very less known species. The known distribution is in Sikkim within 1000-1500 m altitude
11. *Calamus latifolius* Roxb Fl. Ind 3 775 1832; Becc & Hook.f in Hook f. Fl. Brit. India 6 455.1893. (*proparte*)
C. humilis Roxb., Fl Ind 3 773 1832
Long, slender rattan, internode 25 cm apart, diam 1.5 cm, as thick as walking cane, fruit sub-globose, 2.5 cm long, dull yellow, convex scales, deeply channelled, shining, margin narrowly scarious

The species grows in plains, foothills, ascending up to 700 m altitude. Widely distributed in Assam, Arunachal Pradesh ('Houka'), Mizoram ('Ranga') The species is used for tying timber in rafts and making cables which stretch across the river.

12. *Calamus latifolius* var. *marmoratus* Becc.

Occurs in North-eastern Himalayan belt

13. *Calamus leptospadix* Griff. in Calcutta J. Nat. Hist. 5.49 1845 & Palms Brit. India 60, t. 194. A-C. 1850; Becc. & Hook f. in Hook. f., Fl. Brit. India 6 : 441 1892.

Slender, scandent stem, spadices several cm long, fruit 1.5 cm diam., small, globose, mucronate, scales yellow with a red-brown margin.

Occurs in hilly forested areas in between 500-1200 m altitudes of Sikkim ('Dangri' bet), Manipur, Meghalaya, Nagaland and Arunachal Pradesh ('Tita') of the region.

14. *Calamus quinquenervis* Roxb. Fl. Ind. 3 : 777 1832; Becc. & Hook f. in Hook f., Fl. Brit. India 6 : 460 1892

Climbing cane, internodes 15-20 cm apart, ca. 2-2.5 cm diam., fruit spherical

Grows in foothills to mid altitudes (800-1000 m) of Meghalaya

15. *Calamus tenuis* Roxb. Fl. Ind. 3.780 1832, Becc. & Hook f. in Hook f., Fl. Brit. India 6 : 447 1892

C. royleanus Griff. in Calcutta J. Nat. Hist. 5 : 40 1845

Scandent, very long stem, ca. 2.5 cm diam., fruit sub-globose, 1.5 cm diam., mucronate; scales pale with a shallow median channel and very narrow discoloured margins

Occurs in tropical Himalayan belt, preferably in between 500-1000 m altitude. In NE region, it is found in Sikkim, Assam, Meghalaya, Arunachal Pradesh and Tripura where commonly known as 'Jati' bet

Daemonorops Bl. ex Schult. f.

The genus *Daemonorops* is Indo-Malayan in distribution. The genus has got about 100 species but only 1 species is known to occur in NE region of India

1. *Daemonorops jenkinsianus* (Griff.) Mart., Hist. Nat. Palm. 327 1850, Becc. & Hook f. In Hook f., Fl. Brit. India 6 : 462. 1893.

Calamus jenkinsianus Griff. in Calcutta J. Nat. Hist. 5 : 81 1850

Stem stout, grows more than 30-40 m length, 4-5 cm in diam., fruit

globose, apiculate, *ca.* 2 cm diam., pale yellow-brown; scales deeply channelled, margins narrowly scarious.

Commonly known as 'Gola' bet. The species is distributed in Sikkim, Arunachal Pradesh, Assam (Cachar), Meghalaya, North Bengal (Dooars) and Tripura, in between 200-900 m altitude

Used in basket making work.

Plectocomia Mart. & Bl.

There are six (6) Asiatic species distributed in Indo-Burma to West Malaysia through South China. In NE India, 3 species are known to occur. The plants resembles *Calamus* in its habit.

1. *Plectocomia assamica* Griff in Calc. J. Nat. Hist. 5:97 1845; Palms Brit India 107. t. 218aa, 1850; Becc. & Hook. f. In Hook. f., Fl. Brit. India 6:479 1892

Scandent stem. Fruit *ca.* 2.5 cm diam.; bright rusty red, villous from the deeply ciliate split recurved points of the scales.

Poorly known species and rarely found in plains of Upper Assam districts

2. *Plectocomia himalayana* Griff. in Calc. J. Nat. Hist. 5:100 1845, Palms Brit India 108. t. 218 1850; Becc. & Hook. f. In Hook. f., Fl. Brit. India 6:478. 1892

Scandent stem, diam. -3 cm; fruits globose, depressed, 1.5 cm diam., scales very small, tips fimbriate.

Found in Sikkim at an altitude between 1300-2150 m

3. *Plectocomia khasyana* Griff. in Calc. J. Nat. Hist. 5:106. 1845 Palms Brit. India 106. t. 218. 1850, Becc. & Hook. f. in Hook. f., Fl. Brit. India 6:478 1892

Scandent palm, stem long, *ca.* 20-25 m, diam. -7-8 cm, fruit globose, beaked, *ca.* 3 cm diam., scales ciliate with recurved fimbriate tips.

Rarely found in Meghalaya between 1300-1500 m altitude.

UTILIZATION

Most of the species of Rattan that are occurring in climax forests of NE Region are perennial in nature and used for varied purposes. They are used for umbrella handles, furniture, ammunition boxes, walking sticks, polo sticks and basket making after proper drying and seasoning. The commonly used species for this purpose are – *Calamus tenuis*, *C. floribundus*, *C. flagellum*, *C. erectus* and

C. guruba *Daemonorops jenkinsianus* is mainly used for making frames, ribs of different kinds of furniture due to its big diameter. Canes are basically pliable, flexible, elastic and strong and the outer surface is hard, smooth, shining and gets easily varnished. Internodal length, maturity period and seasoning play a vital role for their effective utilisation

Cottage industry on cane is largely spread in Assam (Silchar, Nagaon, Sib-sagar, Tezpur and Sadiya), Meghalaya (Garo Hills), Foothill areas of Arunachal Pradesh and Dooars in North Bengal. Cane strips are especially used for weaving mats and are much in demand during the hot summer. The refuse from the splittings is grounded and sold as crushed cane for stuffing and packing, and for making rough cordage, matting, fibre trunks and a variety of other articles

The soft, tender terminal portion of small sized Rattan is used as cabbage in vegetable preparations. The boiled tender shoots, though bitter in taste, is used to deworm children against round worms. The seeds of *Calamus erectus* Roxb are used as substitutes for betel nut

CONSERVATION

The NE Region is endowed with vast forest resources, which are, however, depleting very fast due to large scale human interference, cane being no exception to this trend. Presently Mizoram, Cachar and Mikir Hills of Assam and Arunachal Pradesh mostly provide the raw material for cane industries in this region. In 1991-92, Arunachal Pradesh alone extracted 6351146 2 Rmt /6504083 Kaps. of canes from their forests. Systematic regeneration programme against this extraction is very meagre. Scientific and taxonomic studies on Rattan in this region also still needed to be undertaken. The importance and future research needs on Rattan have been emphasised from time to time by the INBAR (International Network for Bamboo and Rattan) in their News Letters

Both *in situ* and *ex situ* methods of conservation may be adopted to safeguard the species from its extinction. *In situ* conservation envisages the establishment of protected/reserved forests where the species can grow well in their natural habitat and remain safe and undisturbed. Secondly, the species can be regenerated periodically in new plantation areas where the tall tree species can provide support for their climbing and the cane can be harvested without any damage to the host plant and least disturbance to the ecological niches. This regenerated Rattan species can meet the demand of raw materials for nearby cottage industries

Ex situ conservation will involve the collection of mature seeds and preserving them in gene banks. The seeds may remain viable in the gene bank, under specific conditions over a long period. Alternatively, the clones may be preserved in clonal repository for future use

Judicious extraction, utilisation and adoption of conservation strategies only can save the invaluable genetic diversities of Rattan in this region. Through this means only, it is possible to keep cottage (cane) industries viable which may uplift the local socio-economic conditions to some extent.

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Management of *Frerea indica* Dalz., an Endangered, Wild Edible Plant — A Case Study

P. Tetali

INTRODUCTION

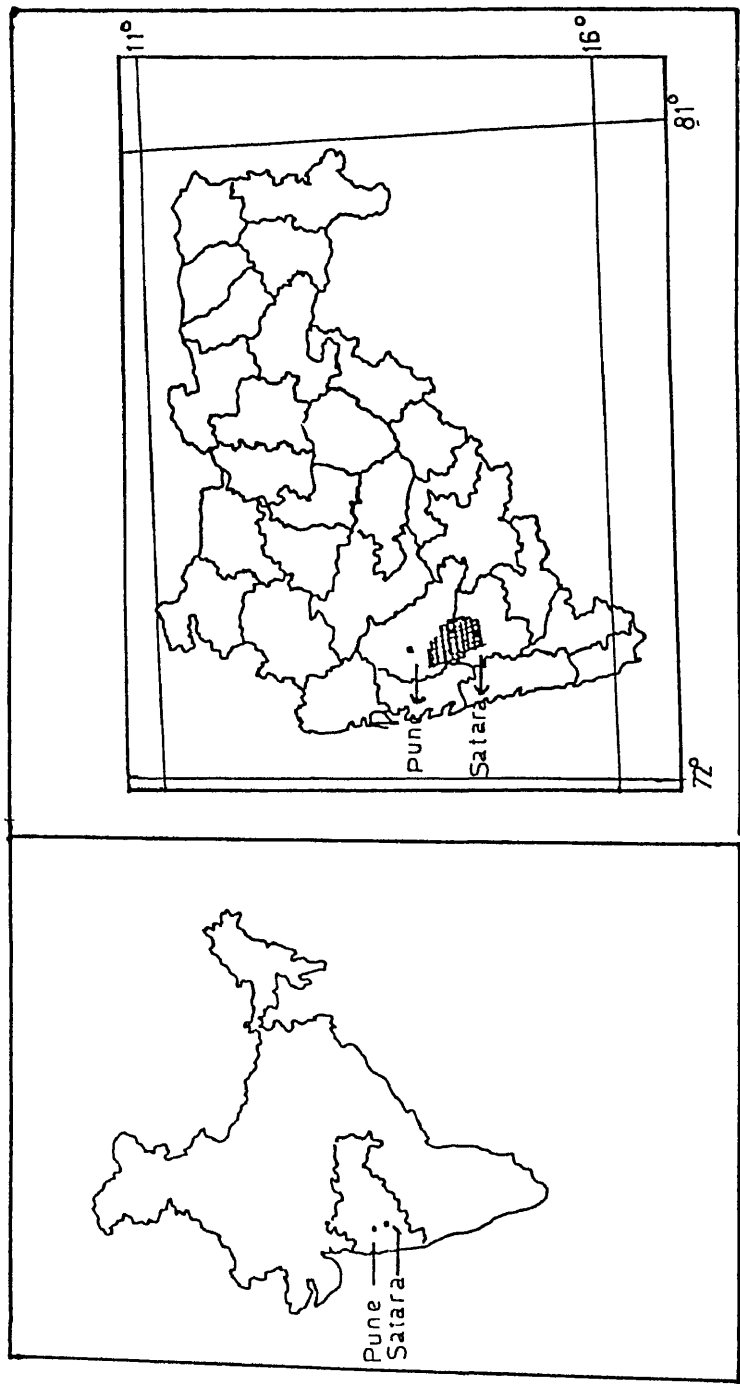
Frerea indica Dalz. is a low, succulent herb belonging to the family Asclepiadaceae. The monotypic genus is in danger of extinction and its survival is unlikely if serious conservation and management measures are not undertaken immediately. The present paper highlights various management strategies adopted in *ex-situ* conservation at our research station at Shindewadi in the Satara District of Maharashtra State (Fig. 1). The plant thrives well on good aerated red laterite soils. Propagation can be carried out through seeds and stem cuttings. Caterpillars pose major threat to its successful survival. Further, the study shows that logical conservation strategy would help attracting the right pollinator as well as follicle formation.

Botanical Characteristics

It is a low, fleshy glabrous perennial with drooping branches, reaching to 40 cm or more in ideal conditions. Stems one to two centimetres across. Leaves opposite. Flowers star shaped, solitary or in pairs, arising from in between the petioles and opening on the ventral side of the leaf. Corolla crimson to cherry-red and decorated with apple-white or pasture-white spots or crimson colour striations, designed like a spider web.

Distribution

F. indica has been reported from only three localities in Maharashtra State, i.e., Junnar, Purandhar and Sajjan 'gad', hill forts respectively. The species presently occurs only on the hill cliffs of Purandhar fort and Sajjan gad (Dalzell 1865, Santapau 1951 and Kumbhojkar *et al.*, 1963) (See also Map-1). It is a palaeoendemic species. In the wild, its occurrence is very rare and seen growing in small batches, comprising very limited number of individuals. There are only 10 to 15 populations believed to occur in the wild.



Map I Distribution of *Frere indica* Dalz in Maharashtra State

Fig. 1: India Map-Maharashtra State

Why Study *F. indica*? - It's Significance

The vernacular name of *F. indica* is **Makad Shengi** (Monkey's horn) a corrupt name of closely related and resembling species *Caralluma fimbriata* Wall and is eaten as vegetable.

F. indica is represented by only one species (monotypic)

Absence or extinction of pollinators is believed to be the sole reason for poor follicle formation

F. indica in recent decade has been listed as an endemic, threatened and endangered plant species Jain & Sastry (1980), Nayar & Sastry (1987), Ahmedullah & Nayar (1985). It has also been declared as one of the twelve most endangered plant species on earth by the International Union for Conservation of Nature (IUCN) and has an excellent potential to be introduced as an ornamental plant provided conservation and propagation methods are evolved.

MANAGEMENT STRATEGIES

Management of an extremely rare species like *F. indica* is not an easy task. Besides *in situ* conservation, *ex situ* conservation is equally important. In the course of investigation, it was realized that in order to manage the species, research studies have to be carried out on different aspects as mentioned below. The anticipated data obtained in this direction, is expected to give an insight into the various needs of the plant and its management in places other than its natural habitat.

Research studies can be broadly planned under three categories.

- i) ecological and pollination studies,
- ii) propagation and multiplication methods, and
- iii) pests and diseases.

The gist of the data collected so far has been sequentially presented in the following text

Habitat

F. indica has been reported so far from high altitudes, on the hill cliffs, generally inaccessible to human beings. It grows in the rock crevices and requires a very thin film of soil. The roots are small, delicate, up to six cm long. In the dry season, the whole plant becomes leafless and forms a thin silvery non-living layer around the stems to prevent transpiration. During this stage it resembles *Caralluma fimbriata*.

Soil

F. indica grows well on red laterite soils. The plant prefers slightly acidic soils

(5-7 pH). However, for a better growth, the following substratum is found to be ideal (Table-1)

Table-1: Soil Substratum Components

Red lateritic soil	2 parts
Peralite	1 part
Vermiculite	1 part

Water

The plant cannot withstand waterlogging or over-watered conditions. Depending upon the season and locality, a tentative watering schedule is given in Table-2

Table-2 Watering Schedule

Rainy season	no watering is required
Winter season	once in two to three days
Summer season	once in a day

Light

F. indica grows well under partially shaded conditions. Good growth is obtained under 60% shaded net in comparison to open places. Light requirement study is under way in order to find out its suitability as an indoor plant.

Spacing

In nursery conditions, the only spacing tried was 25 × 30 cm. The distance appears to be reasonably good.

Flowers - Follicle Formation - Seeds

F. indica flowers throughout the year in nursery conditions. However, follicle formation is very rare (McCann 1939). The star-shaped flowers exhibit a variety of designs. It takes 10 to 20 days for a bud to reach maturity. Flowers remain open for two to four days. On the fourth day, petals deflex and finally wither away.

The poor fruit set is believed to be due to the complicated pollinia translator mechanism which depends on the visit of an insect pollinator which is perhaps no longer available to it (Ahmedullah & Nayar 1985). Absence of pollinators is attributed to the palaeotropic endemic nature of the species (Ahmedullah & Nayar 1985).

Autecology

Autecological studies were undertaken with a view to understand the ecological needs of the species for propagation and cultivation. *F. indica* and two more closely related species, *Caralluma fimbriata* Wall and *Ceropegia bulbosa* Roxb of similar habitat, were raised in wooden trays in our research garden. These species were grown either alone or in combination (mixed stands). Follicle formation took place in trays in which it was growing along with *C. bulbosa* in the months of November, December and January. In the same season, *C. bulbosa* also set follicles profusely. In many cases, pod formation took place after a long span (one month or more). Pods appear from December onwards and reach maturity from March onwards. The follicles are straight, cylindrical, finely pointed, glabrous and five to nine centimetres in length. The seeds are brownish black, comose, compressed on one side, about 1 cm in length, ovate-oblong (See also Table-3). It is found that number of seeds per pod is dependent on the length of the pod. Pod formation is not found related to the number of flowers, but is a pollinator-dependant. Seed germination and number of days required for germination is shown in Fig. 2.

Table-3: Main observation during autecological studies

Seeds germination	begins from third day onwards
Branching	begins in the third month
Time taken for flowering after germination	8 -12 months
Pod length	5-9cm
Number of seeds per follicle	6-52
Percentage of seed germination (from 1-5 months after dehiscence)	90-94%

Insect Visitors

Insect pollinators which visited the flowers of *F. indica* are *Danus chrysippus* (plain tiger), *D. genuita* (striped tiger), *Musa domestica* (house fly) and *Mono-morium* sp (black ant).

Propagation Methods

F. indica can be propagated through seed and stem cuttings. In both the cases, excellent results have been obtained.

By Seeds. The seeds readily germinate and give rise to radicle first. Germination percentage is excellent, above 94%. Seeds are not viable for longer periods. About six month old seeds, when tried for germination, were found to be non-viable. The plant grows slowly, branching begins from third month onwards.

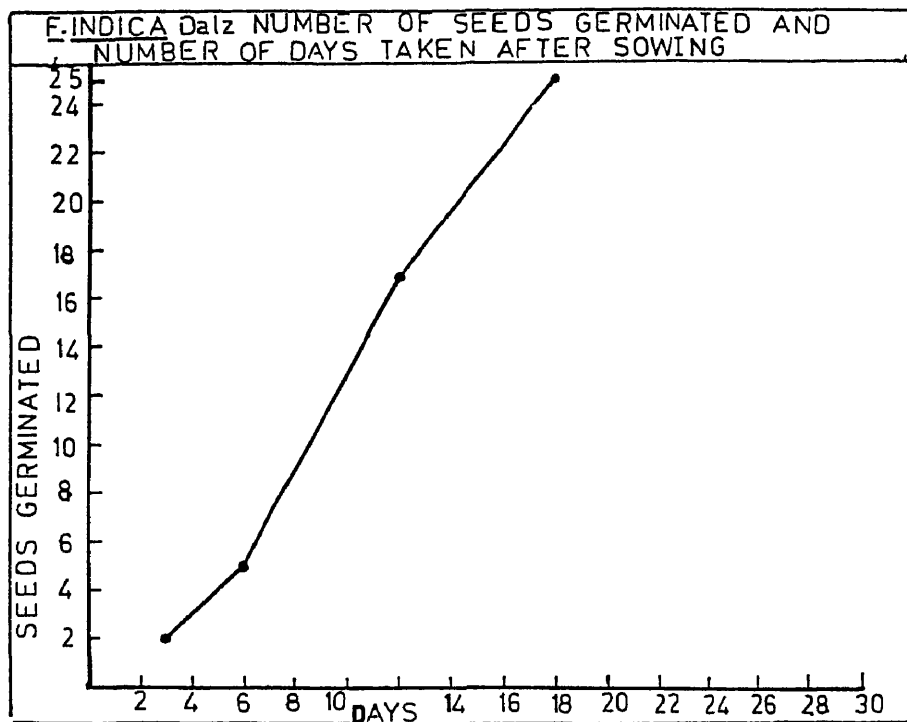


Fig. 2.

Stem Cuttings The drooping branches on touching the ground surface, form roots and develop into a new plant. In dry season, branches shrink and form notches which root and on finding suitable condition can give rise to new plants after falling from mother plant or new plants can be raised easily by transplanting them.

Pest and Diseases

The plant is commonly infested by two types of insects. They are caterpillars of plain and striped tiger and *Aphis* sp (aphids). The former is a serious pest. Ignoring it is almost catastrophic. The aphids feed on slender shoots and caterpillars on leaves, pods and defoliate the leaves. The following treatments are suggested for controlling the populations.

For Aphids Spraying Carbaryl 0.1%, Malathion 0.1% or *Acorus calamus*

infusion (prepared by soaking 7.5 to 15 gm rhizome powder in 5 litres of water with equal quantity of soap).

For Caterpillars· Dusting 10% BHC, Methyl parathion 0.05% or the caterpillars can be hand-picked and killed

CONCLUSION

The study shows that *F. indica* can be very well domesticated. However, before coming to any conclusion, we are working on nutrition requirements, floral biology, pollinator identification, edible value and possibility of growing it like an indoor plant. The studies carried out so far show that the plant has a definite potential for the uses mentioned already.

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